SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JANUARY 1904.

GENERAL PHYSICS.

1. *Bathymeter for Determining the Depth of Liquid in Distant Vessels.* **L. Murphy.** (Roy. Dublin Soc., Econ. Proc. 1. pp. 167–178, April, 1903.)—This instrument consists of a closed vessel, the upper part of which communicates, through a line-pipe of fine bore, *e.g.*, ⅛ in., with the bottom of a well or other liquid-receptacle. The closed vessel is also provided with an air-pump, arranged to pump air into it, and with a pressure-gauge to register the pressure therein. Air is pumped into the closed vessel until the pressure remains stationary, *i.e.*, until the air bubbles out at the bottom of the line-pipe, whereupon the reading of the pressure-gauge gives the depth or head of liquid. A special form of air-pump having a mercury seal to prevent leakage while the reading is being taken is also described. The pump is preferably made of such dimensions that one stroke is more than sufficient to fill the whole apparatus and the line-pipe with air. C. K. F.

2. *Experiments with Salvioni's Micro-Balance.* **J. Giesen.** (Ann. d. Physik, 10. 4. pp. 830–844, March, 1903.)—The author describes a number of experiments made with a modified form of Salvioni's micro-balance, which consists of a fine glass thread fixed at one end and loaded at the other, the load being measured by the deflection of the beam, read off by means of a microscope. [See Abstract No. 1986 (1902).] Such a balance, by means of which weights as small as 0·001 m. grm. may be accurately estimated, is especially suitable for the determination of the specific gravity of gases, the measurement of the weight of water vapour condensed on the surface of solid bodies, and the study of the adsorption of gases. T. H. P.

3. *New Mounting for Crossley Reflecting Telescope at Lick Observatory.* (Scientific American, 88. p. 376, May 16, 1903.)—The original mounting proved unsuitable for photographic exposures, owing to flexure, &c. In the new one, the 3-ft. diam. telescope tube, with its mirror of 17½ ft. focal length, is attached to a heavy steel declination axis passing through the middle of a 14-ft. polar axis with counterweight the other side. This polar axis is supported on two separate piers, the northern one being 8 ft. high and built up of steel plates on a 6-ft. concrete foundation, whilst the south bearing plate, with ball thrust, rests directly on its concrete bed. For adjustment

the bearings are cylindrical in a direction at right angles to the polar axis. The steel telescope tube is built up in six parts, of which the lowest is circular in section and contains the mirror; next comes a cubical part attached rigidly to the declination axis, and above this four more circular sections, the topmost of which carries the photographic plate at its centre. A clock with conical pendulum drives the north end of the polar axis by means of two sectors, each of 8-ft. radius, which come into action alternately. The main telescope is directed by, and combined with, an auxiliary guiding telescope. H. F. H.

4. *Flow of Gases in Pipes.* **H. Lorenz.** (Phys. Zeitschr. 4. pp. 333–337, March 15, 1903.)—This paper is a mathematical development of the subject. When the velocity of stationary flow becomes equal to the velocity of sound, there is in general a sudden change of pressure. The velocity attains a maximum only during falling pressure, in a widening tube. In the diagram of pressures as functions of the diameter, the curves of pressure at the points of greatest velocity form an equilateral hyperbola. For each gas in a given divergent tube there is only one diameter at which the maximum velocity of flow is equal to the velocity of sound. The quantity flowing in divergent tubes, below a given external pressure, but with a constant original value of *p.v.* (internal), remains constant; but above this limit, until the external pressure is equal to the internal, it rapidly falls off. A maximum or minimum of pressure can only occur at places with increasing diameter, and there the velocity falls off. The theory explains the sudden increase of the resistance to a shot when the velocity comes to exceed that of sound. A. D.

5. *Effect of Electricity on the Internal Friction of Liquids.* **G. Ercolini.** (N. Cimento, 5. pp. 249–257, April, 1903.)—Pacher and Finazzi, experimenting with a condenser formed by two co-axial cylinders, have found that an electric action is without effect on the internal friction of liquids, as König had previously stated, though Duff and Quincke [see Abstract No. 106 (1898)] were of the opposite opinion. According to the author it is difficult to know if in these experiments heat or other causes had any influence, and he experiments with a similar condenser; if there is an internal change in the friction of the liquid this will induce a change in the oscillation. The author finds that the electric action of a Ruhmkorff coil, the secondary of which gave a potential of 9,000 volts, on petroleum, benzine, turpentine, olive oil, and vaseline oil, does not cause a change of 1 per cent. in the internal friction of the three first-named liquids, though the change is 10 per cent. in the case of the other two. A. F.

6. *Dust Figures.* **W. J. Russell.** (Roy. Soc., Phil. Trans. 201. pp. 185–204, May 28, 1903. Roy. Soc., Proc. 71. pp. 285–287, March, 1903.)—The author gives records and results of observations of singular definite figures produced by the deposition of dust (say, MgO from burning Mg ribbon), on plates uniformly but not too much warmed and enveloped by the dusty atmosphere; with modifications produced by variations in the experiments, such as the presence of a bunsen burner, or even of a pin in the neighbourhood. The magnesia seems to cohere, to form *quasi*-fibres. A. D.

7. *Rigidity Modulus of Rocks.* **S. Kusakabe.** (Mathematical and Physical Soc., Tokyo, 1. 14. pp. 103–111, 1901–1903.)—The paper summarises

experiments on various kinds of rocks, and shows that Hooke's law does not generally hold, even for very small twists, and that great torsional hysteresis exists. The rigidity modulus is a function of the previous history of the specimen; it diminishes when the specimen is repeatedly twisted, diminishes also when the couple acting on the specimen increases, and increases when the specimen is in twisted state. The two last, apparently inconsistent statements, are explained by the torsional hysteresis. W. S.

8. *High Vacua for Distillation.* **E. Erdmann.** (Ber. Deut. Chem. Gesell. 36. pp. 3456–3461, Oct. 24, 1903.)—High vacua for distillation under reduced pressure can be obtained by filling the apparatus with carbon dioxide, and cooling a part of it with liquid air. Liquid carbon dioxide contains 0·75 per cent. by volume of dissolved air and cannot be used, but carbon dioxide snow gave good results; the dissolved air contains 24·1 per cent. of oxygen by volume. The best method is to fill the apparatus with carbon dioxide prepared from marble and hydrochloric acid, and exhaust to 30 mm. by means of a water-pump; this operation is repeated three times in order to free the apparatus from air, and on cooling an attached tube to – 190°, the pressure falls to a minimum of 0·08 mm. when rubber connections are used, though the vacuum of the kathode light can be obtained if these are eliminated. T. M. L.

9. *Liquid Films Formed by Condensation at the Surface of a Solid.* **G. J. Parks.** (Phil. Mag. 5. pp. 517–528, May, 1903. Communicated by the Physical Society.)—The experiments are made upon cotton silicate which is packed into a test tube and allowed to acquire a surface film of water. By finding the increase of weight, the thickness of the film for various exposures is calculated. Thus, after 1 day, $8·3 \times 10^{-6}$ cm.; after 10 days, $12·8 \times 10^{-6}$; after 16 days, $13·4 \times 10^{-6}$. J. W. P.

x 10. *The Problem of Columbus.* **H. W. Chapman.** (Phil. Mag. 5. pp. 458–476, April, 1903.)—The author determines completely the motion of an egg-shaped body (symmetrical about an axis and with a hemispherical end) on a perfectly rough horizontal plane. The results show: (1) That the axis of an egg-shaped body would not rise towards the vertical unless, when its axis is horizontal, it receives not only a spin about the vertical, but also a rolling motion round its axis; (2) that even when so spun, it is very improbable that its axis would rise to the vertical. The rising observed in the case of smooth wooden eggs is connected with the phenomenon of limiting friction, and a rough cement egg rose only with difficulty, and usually remained oscillating between two cones, as required by the theory for a perfectly rough egg. W. S.

11. *Lagrange's Equations for Non-holonomous Generalised Co-ordinates.* **L. Boltzmann.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1608–1614, Dec., 1902.)—A mechanical system of two wheels and a driving belt is described, having the property that a change in the position of the belt causes a change in the ratio, r_1/r_2, of the radii of the two wheels. For co-ordinates defining the position of a point P on or connected with the second wheel, we might take r_2, the radius of the second wheel, and w_1 the angle turned through from a given position by the first wheel. Such co-ordinates are not holonomous, for if we affect r_2 and w_1 with the variations ∂r_2 and ∂w_1, the consequent

change in the position of P will depend on whether the variation ∂r_3 takes place before or after ∂w_1. The kinetic energy of the system is—

$$T = \frac{1}{2}(K + 4a^2)\left(\frac{dw_1}{dt}\right)^2 \text{ where } a = r_1/r_3.$$

If from this we form the Lagrangian equations in the usual way, they give the correct form for the force tending to increase w_1, but they also give forces tending to increase co-ordinates which define the position of the belt, and these latter forces, the writer says, ought to be non-existent. He proceeds to consider the modifications which Lagrange's equations must receive in cases of this kind. He assumes a system of n material points, having $3n$ co-ordinates $x_1 \,.\,.\, z_n$, but between these exist a number σ of equations of condition. The system has then degrees of freedom $3n - \sigma$. It might be represented therefore by $3n - \sigma$ generalised co-ordinates $p_1 \,.\,.\, p_s$, &c. But of these some may not be holonomous. Let q_h be the generalised component of momentum corresponding to p_h. Then he gives the terms that must be added to the ordinary $\frac{dq}{dt} = P + \frac{dT}{dp}$, in order that the use of Lagrange's equations may be legitimate. S. H. B.

12. *Gravitation and Capillarity.* **G. Bakker.** (Ann. d. Physik, 11. 1. pp. 207–217, April, 1903.)—Laplace had remarked that if only we attribute to molecules sufficient density the phenomena of capillarity might be explained by gravitation, and the same theory had been maintained in a popular work by Kelvin. In the present paper the question is investigated scientifically. It is pointed out to begin with that Laplace, Gauss, and others who have investigated the potential due to a liquid, assume the liquid to be continuous in space, and not to consist of discrete molecules. Boltzmann, on the other hand, considers the potential of two molecules in a rare medium, on the assumption that no molecule is ever within the radius of action of more than one other at the same instant. That being assumed, and χ denoting the mutual potential at distance, r, $e^{-2h\chi}dr$ is said to represent the number of molecules which are at any instant within the spherical shell $r \,.\,.\, r + dr$, described about a type molecule that is, by virtue of the assumption made, the chance that there shall be one such other molecule. The reasoning on this basis is open throughout to criticism, and, like other work of the author, deserves criticism. The best course in an abstract is to give the writer's conclusions and let the reader form his own opinion. The conclusions are as follows: (1) The capillary forces, as observed experimentally, are forces between masses of molecules, not between individual molecules. (2) If the diameters of molecules are small enough compared with their mean distance from each other, the law of gravitation sufficiently explains cohesion. (3) The constant A in the expression for the potential given by Gauss and van der Waals on the assumption of the Newtonian law of force, namely, $W = -A\rho$, where ρ denotes density, diminishes as temperature rises. (4) Gives an expression for the potential function between two elements of the continuous medium which takes the place of the gas or liquid. (5) For sufficiently high temperature the cohesion of a gas is sensibly zero. S. H. B.

13. *Waves of the First Order with regard to Velocity within a Vitreous Medium.* **P. Duhem.** (Comptes Rendus, 136. pp. 858–860, April 6, 1903.)—This note is a continuation of the author's former discussions on vitreous

media, and employs the same notation. [See Abstract No. 1146 (1903).] It is impossible to give the mathematical work in an Abstract, but the conclusion arrived at is as follows: "The only waves of the first order with regard to the velocity components u, v, w, which can continue to exist in a vitreous medium having viscosity, are those waves which continue to separate the same parts of the medium. Such a wave is a surface of discontinuity for the density ρ, and for the quantities N_t, T_t of the former memoirs. If the medium is a good conductor, the wave is a wave of the first order for the temperature T. If the medium has no conductivity, it is a surface of discontinuity for T."

S. H. B.

14. *Protection afforded by a Wire Net against Gas Explosion.* **H. Mache.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1223–1228, Oct. and Nov., 1902. From the II. Physik. Institut der Wiener Universität.)—A stream of explosive gas mixture flows from right to left with velocity u through a wire net, and is then ignited. The explosion travels in all directions with velocity c, and c being greater than u (which is assumed), the explosion travels back towards the net with velocity $c - u$. It is observed that it does not pass through the net, but having reached a point at some distance to the left it remains stationary. The author proposes to explain the theory of this phenomenon. According to him, in the flame of the explosion meet two sheets of gas, whereof one has the very high temperature due to the heat set free in combination of the mixed gases, and the other the comparatively low temperature of ignition. Corresponding to this a stream of heat $W = c\rho\gamma(\tau - t)$ flows from the surface of ignition, in which c is the velocity with which the explosion spreads, ρ the density, γ the specific heat, τ the temperature of ignition. And t is the temperature to which the gas, coming from the right, is brought by conduction and radiation from the ignited mass. That gives $c = W/\rho\gamma(\tau - t)$. Were there no wire net, this is the velocity of the explosion. The presence of the wire causes a part of the conducted heat, which should have gone to heat the advancing gas, to be abstracted by the wire. Consequently t is diminished and therefore also c, as the above formula shows. At a certain distance "d" to the left of the wire c becomes equal to u, and so the speed $c - u$ with which the explosion travels becomes zero, and the explosion stationary. This is the theory. The paper ends with a calculation of "d."

S. H. B.

15. *Attempt to estimate the Amount of Krypton and Xenon in Air.* **W. Ramsay.** (Roy. Soc., Proc. 71. pp. 421–426, April 30, 1903.)—In the Hampton liquefier it was found that a little under 6 per cent. of the air was liquefied when running at about 0·25 kg. per minute at 190 atmospheres pressure. The amount of argon in the liquefied air was nearly doubled. It was separated, and 12 litres of it were fractionated with the following results: Air passed through liquefier, 191·1 kg.; air liquefied, 11·3 kg. (5·91 per cent.); argon, 21·3 gm. (·0118 per cent. or 0·1885 per cent. of the liquid air); krypton obtained 0·0028 gm. (·000014 per cent. by weight of the original air), and xenon ·0005 gm. (·0000026 per cent. by weight of the original air). This corresponds to: Krypton, 1 part by weight in about 7 millions of air, or by volume 1 in 20 millions; xenon, 1 in 40 and 1 in 170 millions respectively. From the density of carefully purified krypton its atomic weight is 81·62; mean of former determinations 81·28. [See also Abstract No. 2415 (1901).]

S. R.

16. *Aerial Soundings in Jutland.* **L. Teisserenc de Bort.** (Monthly Weather Rev. 31. pp. 177–178, April, 1903.)—With the co-operation of Hildebrandsson and Paulsen, the author has established a Franco-Scandinavian station near Viborg, a tower of two storeys, 10 m. in height, turning on rails and containing registering instruments and two windlasses and an electric motor for kite flying. There are further an engine shed, balloon shed, testing rooms, workshop, and accommodation for the five regular observers—two from France, two from Sweden, one from Denmark—and their assistants and men. Kites and paper balloons of 30 cub. m. are sent up continuously; ruptures of the wire lines are still numerous, but the instruments are generally recovered. Kites easily rise to 2,000 m., rarely much higher. H. B.

17. *Theory of Vertical Air Currents.* **F. M. Exner.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 345–369, April–June, 1903.)—Developing the formulæ given by A. Schmidt [see Exner, Abstract No. 873 (1903)], the author concludes that, stationary conditions presumed, the decrease in the pressure with increasing altitude should always act in the same way as increased gravity would, both for cyclones and anticyclones. The latter point does not agree with Teisserenc de Bort's deductions, but the general conclusions would be confirmed by A. Angot's observations on the Eiffel Tower. It would result that the pressure at the foot of a mountain should, with vertical currents, be greater than we derive from barometric reductions; and this deduction would affect barometric altitude determinations. Referring to observations made on various mountain stations, and taking temperature and condensation into consideration, the author argues that low pressure on the earth's surface should lead to ascending currents in the lower, and to descending currents in the higher strata; the converse should also hold. [See also Abstract No. 1823 (1902).] H. B.

18. *On the Equilibrium of a Planetary Ellipsoid of Revolution supposed Elastic and Isotropic.* **A. Viterbi.** (Acad. Lincei, Atti, 12. pp. 249–257, April 5, and pp. 300–308, April 19, 1903.)—The ellipsoid is supposed to be rotating with uniform angular velocity w about its axis of figure. The equation to the rotating ellipse is $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, y being parallel to the axis of figure. The only forces acting are the mutual attraction of the parts of the solid according to the Newtonian law, and the centrifugal force, and the components of elastic force, namely, N_1 in direction x, N_2 in direction perpendicular to the plane of the rotating ellipse, and N_3 in direction y. The constants of isotropy are $\lambda+2\mu$, and μ. The displacements of a point parallel to x and y are u v. Then the author gives the fundamental equations, writing as usual, $\theta=\frac{du}{dx}+\frac{dv}{dy}+\frac{u}{x}$, namely—

$$N_1=\lambda\theta+2\mu\frac{du}{dx},\qquad N_2=\lambda\theta+2\mu\frac{u}{x},\qquad N_3=\lambda\theta+2\mu\frac{dv}{dy},$$

and by virtue of a hypothesis in the introduction $\frac{du}{dy}+\frac{dv}{dx}=0$. He now calculates N_1 and N_3, obtaining $N_1=C\left(\frac{x^2}{a^2}+\frac{y^2}{b^2}-1\right)$ where C is a constant, $N_3=C_1x^2+C\frac{y^2}{b^2}-C$ where C_1 is another constant, and C, C_1 are determined in terms of λ, μ, a, b, and N_2 is also found. Hence the conditions sufficient and necessary for equilibrium are found and stated (equation 14).

In the second part he states that equation 14 of Part I. enables us to solve the following problems: (1) Given the ratio between the constants of isotropy, to determine the greatest angular velocity with which the ellipsoid can rotate about its axis of figure consistently with elastic equilibrium. (2) Given the angular velocity, to determine the value which the ratio of the constants must have in order that the ellipsoid may be in elastic equilibrium. He finds for the first problem for an oblate ellipsoid—

$$w^2<2\pi f\left\{\frac{1+l^2}{l^3}\left(\tan^{-1}l-\frac{1}{l+l^3}\right)+\frac{1}{l^3}\left(\tan^{-1}l-\frac{1}{l+l^3}\right)\right.,$$

$\left(\text{where } l^2=\frac{a^2-b^2}{b^3}\right)$ and f is the constant of the attraction of the ellipsoid.

For a prolate ellipsoid he finds—

$$w^2<2\pi f\left\{\frac{1-h^2}{h^3}\left(\frac{h}{1-h^2}-\frac{1}{2}\log\frac{1+h}{1-h}\right)+\frac{1}{h^3}\left(\frac{1}{2}\log\frac{1+h}{1-h}-h\right)\right\}$$

where $h^2=\frac{b^2-a^2}{a^2}$, the axis b, that of rotation, being now the greater axis. Applying the results to the figure of the earth he finds that it satisfies the conditions. Also that, it being an elastic solid, may be in equilibrium, although the angular velocity exceeds the limit possible for a similar fluid ellipsoid. The ratio between the constants of isotropy, $\frac{\lambda+2\mu}{\mu}$, he gives as 56·18. S. H. B.

19. *Apparent Brightness of a Planetary Body with Three Unequal Principal Axes.* **G. Herglotz.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1331–1391, Oct. and Nov., 1902.)—The author informs us in his introduction to this paper that the light given by the asteroid Eros was observed to vary with a period from maximum to maximum of 2 h. 37 m., or, according to Luizet, Le Cadet, and Guillaume, 5 h. 16 m. To account for the phenomenon hypotheses were put forward (1) of its having different reflecting power on different parts of its surface, (2) of its consisting of two bodies which in turn eclipse each other, (3) of its being a non-spherical body with three unequal principal axes, and so presenting to the sun and to the earth a surface varying in magnitude. The writer develops in this paper the mathematical theory of such a body in rotation. He starts from the position that one of the three principal axes, C, may be regarded as revolving with uniform angular velocity N_1 round the normal to the invariable plane, and the body rotates with angular velocity N_2 round C. The attraction of the sun is not here considered, but the writer proposes to deal with it in a later communication. If n denote the normal to the surface of the body, A, B, C the principal axes, we have in usual notation, $\cos(nA)=\sin\theta\cos\phi$, $\cos(nB)=\sin\theta\sin\phi$, $\cos(nC)=\cos\theta$, and if Γ denote the reflectivity of the surface, k^2 the curvature of the surface at any point, we have $\Gamma/k^2=X_0(\theta\phi)+X_1(\theta\phi)+X_2(\theta\phi)+$ &c., a series of spherical harmonic functions, and if $\Gamma=$ constant $X_1=0$, or $\Gamma/k^2=X_0+X_2$. From these data the behaviour of the body is developed mathematically. S. H. B.

20. *Path of the Meteor of February* 27, 1901. **G. v. Niessl.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a, pp. 141–180, Jan.–March, 1903.)—This was a rather conspicuous meteor which attracted attention in Austria. Details of a number of observations are given, from which the position of the radiant is calculated to be $\alpha=157^{\circ}\cdot2$, $\delta=+28^{\circ}\cdot6$. This does not coincide with any known

radiant, but a list is given of several in the neighbourhood. Positions derived from the above for other epochs, on the assumption of a heliocentric velocity double that of the earth, agree with those of some known radiants in different regions of the sky. The colour of the meteor was green or bluish green, turning rosy at the last; and it disappeared at a height of 31·7 km. ± 3·0 km. above the earth. A. E.

21. *Apparent Relations between Heliocentric Perihelion Latitudes and Perihelion Distances of Comets.* **J. Holetschek.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1496–1524, Oct. and Nov., 1902.)—The seventh of a series of similar articles. Letting q stand for perihelion distance, examination of cometary data shows that—(1) Values of $q < 0{\cdot}3$ are chiefly associated with high south perihelion latitude. (2) Values of q from 0·3 to 0·8 with north latitude of all degrees. (3) Values of q near 1 and > 1 with low latitude either north or south. Results (1) and (2) are consequences of the fact that most comet-discoverers dwell in rather high, and chiefly northern, geographical latitudes. With regard to (2) and (3), in general comets have the best chance of discovery when their nearest approach to the Earth occurs at their perihelion passage, since they then appear brightest. This remark does not bear on comets under heading (1), because as a rule these can only be observed when far from perihelion. A. E.

22. *Evolution of Solar Stars.* **A. Schuster.** (Astrophys. Journ. 17. pp. 165–200, April, 1903. Paper read before the Royal Philosophical Society of Glasgow, Nov. 6, 1901.)—In this paper the author deals at length with the modern theories concerning stellar evolution especially in connection with the phenomena observed in the sun. As a result of the views and suggestions he puts forward, the following conclusions are drawn. We may start from matter distributed with approximate uniformity through space and leave out of account whether this matter was in the form of our elements or in some primordial state. In the latter case it may be assumed that the formation of the elements took place with the condensation into larger conglomerations. The effect of the first condensation must have been accompanied by a rejection of hydrogen, helium, and other light gases, because the heat developed must increase their volume so that probably the gravitational attraction will not be sufficient to retain them. The hydrogen and helium will therefore tend to diffuse into the adjoining portions of space. In regions where there is no violent motion it appears that matter will tend to concentrate itself around certain nuclei which will begin to attract each other and clash together. A number of stars will then form, which at first will not contain hydrogen or helium in appreciable quantities. These lighter gases will be left behind as nebulous masses, because unless the gravitation towards the centre of a celestial body exceeds a certain value, light gases cannot form a permanent constituent of the atmosphere. This seems to be a not unlikely explanation of the gaseous nebulæ, as, for example, the nebulous regions surrounding the Pleiades and also the great nebula of Orion. As soon as a star has grown sufficiently large to be capable of retaining the hydrogen and helium, atmospheres of these gases will form round the stars, and the temperature of the photosphere will rise to a maximum. A process of diffusion of the hydrogen and helium into the star will at once begin and may be helped by a process of combination or solution under the pressures now being exerted. The helium will be retained first, being denser than hydrogen, and we may therefore expect helium stars to show the hydrogen lines either weakly or not at all. As a star grows in size the hydrogen will be more and more condensed on its surface from the outside, and we may get a considerable atmosphere of that gas forming round the star. The helium which has first condensed will also first diffuse towards the inside, and we then get the typical hydrogen star. The process of diffusion of the hydrogen, helped quite probably by an absorption due to molecular action, will continue to go on until a stage of equilibrium is reached, in which there is some, but possibly very little, hydrogen near the surface of the star. It is possible that a star may form and never pass through the hydrogen stage at all, either from a deficiency of hydrogen in the neighbourhood or from the star having too small a total mass to retain hydrogen; the former condition might arise from the previous birth of a bigger star in the neighbourhood. On the other hand there may be stars which have attracted too great a quantity of hydrogen to be assimilated; such stars may remain hydrogen stars and never pass through the solar stage at all. The difference between the Arcturian star and solar star may be one of mass; if the former be bigger, it will be able to absorb the hydrogen more completely, and the final state of equilibrium will be such that the hydrogen lines will be thinner than in the solar star. The carbon stars, as far as present evidence goes, appear to be *sui generis*, and the result of condensation in a space where carbonaceous material happened to be abundant.

E. C. C. B.

23. *Theory of Temporary Stars.* **E. F. J. Love.** (Roy. Soc. Victoria, Proc. 15. pp. 1–16, Aug., 1902.)—The observations of Nova Persei (1901) are discussed in order to see what light they throw on the claims of the rival theories of collision and of eruption. The author's view is that, while no cause we know of but collision is competent to originate a *nova*, yet as regards the subsequent spectroscopic phenomena, the evidence disproves the theory which attributes them to the relative motion of different bodies, and shows them to be well explained by disturbances in a gaseous mass. Thus his final conclusion is the following: A collision—the direct evidence of which is not forthcoming—took place in the heavens, resulting in a great development of heat in the colliding masses; this was followed by a tremendous outpouring, in all directions, of incandescent gases. The subsequent history of the ejected gases is disclosed to us by the variations of the bright and dark line spectra, that of the main body by the dying down of the continuous spectrum. These combine to show that the star has throughout retained the general character of an Orion—or at least of a Sirian—star, while the mass of gas surrounding it now differs from an ordinary nebula mainly in its state of aggregation. The exact relation between the outbreak and the changes going on in Ritchey's nebula is a problem for the future to solve.

A. E.

24. *Mass of 85 Pegasi.* **G. C. Comstock.** (Astrophys. Journ. 17. pp. 220–223, April, 1903.)—This star consists of a binary whose components we may call A and B, and of an optical companion which may be denoted by C. The magnitudes of the three stars are 5·7, 11·3, and 9 respectively. Taking as data a series of observations of position, angles, and distances of C referred to A, and also of B referred to A, the author calculates the ratio of the masses of A and B and finds it to be 3 : 5; assuming the parallax of this star to be $+0''\cdot04$, the masses of the two components, in terms of the Sun's mass taken as unity, are found to be $A = 4\cdot3$ and $B = 7\cdot0$. This is a remarkable result:

a star, A, whose spectrum is of the second type, emits more than 100 times the light of its companion B, although B is presumably of equal age with A and possesses 60 per cent. more mass than A. E. C. C. B.

25. *Probable presence in the Sun of the newly discovered Gases of the Atmosphere.* **G. D. Liveing.** (Cambridge Phil. Soc., Proc. 12. pp. 87–92, April, 1903.)—A comparison between the wave lengths of the lines in the spectra of the light and heavy constituents of the atmosphere, as measured by Liveing and Dewar, and the bright lines in the spectra of the solar protuberances, renders it possible that the new gases are present in the sun. [See also Abstract following.] E. C. C. B.

26. *Neon, Argon, Krypton and Xenon in the Chromosphere.* **S. A. Mitchell.** (Astrophys. Journ. 17. pp. 224–228, April, 1903.)—A discussion of the probability of the spectrum lines of these gases being present in the flash spectrum. From a comparison of his own measurements of the latter, and Liveing and Dewar's measurements of the spectra of the more volatile constituents of the atmosphere, the author concludes that neon is probably present in the chromosphere; the measurements of Liveing and Dewar are not sufficiently accurate to justify any final conclusion. Argon apparently is also present, as shown by a comparison of Kayser's measurements of this gas. Krypton and xenon, on the other hand, appear to be absent, as would be expected from their high densities. [See also preceding Abstract.] E. C. C. B.

REFERENCES.

27. *An Accurate Level.* **A. Schell.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 261–295, April–June, 1903.)—A monograph on the construction and use of an exceedingly accurate surveying level. J. E.-M.

28. *Horizontal Pendulum Tromometer.* **F. Omori.** (Mathematical and Physical Soc., Tokyo, 1. 16. pp. 143–148, 1901–1903.)—Detailed description of the instrument, which is intended to register very small horizontal movements, and which is highly sensitive to tremors and quick-period vibrations. H. B.

29. *Three-dimensional Graphical Statics.* **B. Mayor.** (Comptes Rendus, 136. pp. 85–87, Jan. 12, 1903.)—A continuation of the previous notes by the author in this journal. [See Abstract No. 1335 (1903).] W. S.

30. *Deflection Curve of a Straight Beam from the Bending Moment Diagram.* **L. Vianello.** (Zeitschr. Vereines Deutsch. Ing. 47. pp. 92–97, Jan. 17, 1903.)—The author gives a simplified geometrical method for the above construction. W. S.

31. *Mercury-cleaning Apparatus.* **A. O. Doane.** (Eng. Record, 47. p. 205, Feb. 21, 1903.)—A description with diagram of a simple and effective apparatus. J. W. P.

32. *Suspending Instruments on Oscillating Foundations.* **M. Hamy.** (Comptes Rendus, 136. pp. 990–992, April 27, 1903.)—Having some years ago calculated the absolute movement of a body of negligible mass, which is suspended by equal springs attached to the corners of two equal regular polygons, the author shows that instruments may be suspended in this way. A mercury trough placed near a gas engine gave steady reflected images. H. B.

33. *Ascertaining the Personal Equation.* **A. Kittel.** (Zeitschr. Instrumentenk., Beib. 3. pp. 17–19, Feb. 1, and 4. pp. 25–26, Feb. 15, 1903.)—The author gives a description of an apparatus involving the use of an artificial star, and both automatic and personal recording. It may be used for training observers. A. D.

34. *Theoretical Point in the Determination of Joule's Equivalent by Churning.* **C. Raveau.** (Journ. de Physique, 2. pp. 253–255, April, 1903.)—A consideration of the internal forces involved in the experimental methods employed by Joule, Hirn, and Rowland. The justification of these methods is made to depend upon a dynamical theorem, which is stated at length. J. W. P.

35. *Compressibility of Mercury.* **P. Carnazzi.** (N. Cimento, 5. pp. 180–189, March, 1903.)—The author finds that under variations of temperature and pressure the compressibility of mercury follows the same laws as that of other liquids increasing with temperature and diminishing with increased pressure. A. D.

36. *Poisson's Ratio.* **P. Cardani.** (N. Cimento, 5. pp. 73–89, Feb., 1903.)—A method for direct measurement of Poisson's ratio in a wire, based upon the use of a very long wire so that its alterations of volume may be appreciable, and upon enclosing this wire in a tube of constant internal capacity so that the variations in the volume of the wire may be read off by means of liquid in the tube. A. D.

37. *Approximate Solution for the Bending of a Beam of Rectangular Cross-Section under any System of Load.* **L. N. G. Filon.** (Roy. Soc., Phil. Trans. 201. pp. 63–155, April 3, 1903. Roy. Soc., Proc. 70. pp. 491–496, Sept., 1902.)—Solutions are obtained for the rectangular parallelopiped under an arbitrary system of surface loading in the cases in which the problem becomes two-dimensional. Some of the results have been tested by experiment, and agree, on the whole, with observation. W. S.

38. *Special Epochs in Vibrating Systems.* **J. W. Peck.** (Phil. Mag. 5. pp. 511–516, May, 1903.)—In a vibrating system two special states may occur: (1) The system may be at rest in all its parts at the same instant; (2) it may be in its undisturbed configuration at the same instant in all its parts. If these states occur at all, they recur periodically. The author investigates the conditions under which such special states occur. W. S.

39. *Gravity Force at Ten Stations in Tokaido.* **S. Shinjo, R. Otani, S. Shimizu, T. Shida,** and **Y. Homma.** (Mathematical and Physical Soc., Tokyo, 1. 17. pp. 178–184, 1901–1903.)—Relative measurements were made with the aid of Stückrath half-second pendulums. The deviations of g from Helmert's formula are mostly smaller than would be expected from the geotectonic character of the district. H. B.

40. *Destructive Sea Waves.* **H. Nagaoka.** (Mathematical and Physical Soc., Tokyo, 1. 15. pp. 126–136, 1901–1903.)—The author shows mathematically that the *seiches* of lakes and destructive sea-waves are similar phenomena hydrodynamically, and classifies destructive sea-waves. W. S.

41. *Temperature, Salinity, and Colour of the Northern Adriatic.* **J. Wolf.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 297–308, April–June, 1903.)—The author tabulates the material collected by the late J. Luksch. Luksch took observations in January and February, 1901, at six stations, A. von Pokorny from March 9 to 16 at six other stations. H. B.

42. *Temperatures of Springs at Different Altitudes.* **F. v. Kerner.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 421–492, April–June, 1903.)—The paper is based upon materials collected by the author's father, the late A. Kerner, and the author, and concerns about three hundred springs of the basins of the Danube and Inn, and situated at altitudes up to 2,500 m. in valleys, on plateaux, and slopes of the Central Alps and Voralps, and of the southern edge of the Bohemian plateau. The author discusses the determinations of the mean annual temperatures of the springs and the resulting chthonian isothermals. H. B.

43. *Volcanic Dust of Mont Pelée.* **A. B. Griffiths.** (Chem. News, 88. p. 231, Nov. 6, 1903.)—The author gives the results of an analysis of a dust sample collected on Martinique. H. B.

44. *The Soufrière of Guadeloupe.* **A. Lacroix.** (Comptes Rendus, 136. pp. 656–659, March 16, 1903.)—There are two centres of volcanic activity on Guadeloupe, the Soufrière and the Montagne de l'Echelle; the latter was studied by Le Boucher in 1890. The author deals particularly with the fumaroles, which have always been known and have not changed in nature since the last eruption of 1837 H. B

45. *Eruption on St. Vincent.* **A. Lacroix.** (Comptes Rendus, 136. pp. 803–807, March 30, 1903.)—The author ascended the Soufrière accompanied by Deville, Hovey, and Huckerby. The level of the lake on the old crater which had been in occasional eruption for some time, was found to be considerably lower than formerly, being now at least 750 m. below the tops of the almost vertical walls. Enormous clouds of steam and mud were discharged at intervals. H. B.

46. *Air Currents on the Säntis and their Annual Period.* **J. Hann.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 371–411, April–June, 1903.)—The author discusses Billwiller's hourly wind records for the period 1886 to 1900. The winds are chiefly from the N.E. in winter, from the W. in summer, and from the S. and S.E. in autumn; the W.S.W. winds have the greatest velocities, the N. and E. winds the smallest. [See also Abstract No. 1325 (1903).] H. B.

47. *Storm of March 29, 1903.* **Mascart.** (Comptes Rendus, 136. pp. 529–530, March 2, 1903.)—At 7 a.m. the barometer was at 775 mm. at Korta, Azores, and at 725 mm. on the north coast of Ireland; the wind velocity was 40 metres per sec. on the top of the Eiffel Tower. The communication was made on the day of the storm. H. B.

48. *Solar and Meteorological Cycle of 35 Years.* **W. J. S. Lockyer.** (Nature, 68. pp. 8–10, May 7, 1903.)—The author gives the sunspot area curve and rainfall curves for Greenwich, the British Isles (Symons and Shaw), Rothesay, Brussels, Madras, Bombay, Cape Town, and the Upper Ohio Valley, showing the Brückner period. Sunspot minima, following cycles of greatest spotted area, coincide with rainfall maxima. H. B.

49. *Solar Prominence and Spot Circulation,* 1872–1901. **N. Lockyer** and **W. J. S. Lockyer.** (Roy. Soc., Proc. 71. pp. 446–452, May, 1903.)—Examination of the records of Tacchini, Ricco and Mascari, and Fényi shows that the centres of action of prominence activity undergo a regular variation, and move from low to high latitudes in the opposite direction to sunspots. At prominence minima the prominences are confined to latitude ± 44°, while the simultaneous sunspot minima occupy two zones in each hemisphere; at other times the spots have one zone, the prominences two in each hemisphere. [See also Abstract No. 291 (1903).] H. B.

LIGHT.

50. *Japanese Magic Mirrors.* **T. Thorp.** (Manchester Lit. and Phil. Soc., Mem. 47. 8. pp. 1–5, April 28, 1903.)—Moulds made from magic mirrors are themselves magic when polished. In the magic mirrors some parts are raised and become more highly polished than others, apparently on account of the differences of level and not of the metal itself being locally more susceptible to polish. Straining a magic mirror brings out the design. If a casting be polished while under strain, relieving the strain brings out the design. A. D.

51. *Röntgen Stereographs.* (Elect. Rev. 52. pp. 691–692, April 24, 1903.)—The instrument used is a combination of a hand stereoscope with a wide-angle photographic camera, and was devised by B. Walter. The Röntgen stereographs—which are too large for direct stereoscopic vision, while Wheatstone reflecting stereoscopes lose luminosity and confuse the detail—are focussed on the ground glass to standard stereoscopic size; the ground glass is removed and the aerial image is inspected through the stereoscopic lenses. A. D.

52. *Testing Glass used for Optical Purposes.* **E. Zschimmer.** (Zeitschr. Instrumentenk., Beib. 7. pp. 53–55, April 1, 1903.)—Glass is tested with regard to its power to resist the action of air and moisture, of perspiration from the fingers, and of water. The first is done by passing moist air at 60°–70° C. over the specimen, a good glass, such as Jena boro-silicate crown glass, being placed alongside while the specimen is being observed in a special chamber under the microscope. For the second, the glass receives a drop of a solution of 0·5 per cent. conc. acetic acid, and 0·05 per cent. of glycerine in water. This is washed off in 24 hours and the quality determined from the distinctness of the spot. The third effect is looked for after the specimen has remained half immersed in water for two or three days; the second and third effects are found largest in strongly basic glasses, such as flint glass. G. E. A.

53. *Spherical Aberration of the Eye.* **E. Edser.** (Nature, 67. p. 559, April 16, 1903.)—The author describes a simple method of observation by covering the pupil with a card until rays pass only through the margin of the pupil: then a line at the least distance of distinct vision appears depressed, one at ∞ appears raised. When accommodated for near vision the optical system is over-corrected for spherical aberration; when at rest it is under-corrected. A. D.

54. *Parallax Determinations by Photography.* **C. E. Stromeyer.** (Manchester Lit. and Phil. Soc., Mem. 47. 3. pp. 1–4, April 28, 1903.)—The method described in this paper consists in superposing the image of a negative photograph, taken at one period or position, and the image of a positive transparency taken at another period or position. If the two images were identical, then the result of the combination would be a field of uniform tint; if, however, there are changes of position, the two images will register only locally, and the relative displacements can be measured. The superposition may be carried out either by placing one photograph upon the other, or by using two lanterns and superposing the two images upon a screen. The author suggests various applications of the method, amongst which may be mentioned surveying, stellar motions, and changes of brightness in stars, comets and nebulæ. E. C. C. B.

55. *New Method for adjusting a Telescope horizontally.* **A. Berget.** (Comptes Rendus, 136. pp. 883–885, April 6, 1903.)—A vertical mirror, consisting of a plane parallel glass plate with both faces silvered, is hung by two steel bands, having their upper ends clamped in a horizontal grip. The inclination of the mirror can be altered by means of screw counterpoises. The telescope is pointed at the mirror, and adjusted till the cross-wires in its field coincide with their reflections. The mirror with its supporting bands is then reversed, and the process repeated for its second face. A position of the telescope midway between the new and old directions should be horizontal, and on readjusting the mirror to correspond, the mirror will be vertical. The operation is repeated two or three times with increasing approach to accuracy. Any error of parallelism in the mirror faces can be determined once for all, and allowed for. A. E.

56. *Determination of the Chromatic Curve of Objectives.* **G. Eberhard.** (Zeitschr. Instrumentenk. 23. pp. 82–88, March, 1903.)—In principle, the author's apparatus is a spectrograph with a collimator lens of very long focus (3400 mm.) compared to the focus of the camera lens (350 mm.) With this arrangement, if a slight change be made in the distance of the slit from the collimator lens, the corresponding change for the distance from camera lens to plate is negligible. Similarly the focal differences of the collimator for different colours have no practical effect on the camera adjustment. The collimator lens being supposed fixed, the adjustment of the camera for getting a sharp picture depends only on the chromatic curve of the camera lens itself, a fact which affords a means of obtaining the curve. An arc lamp with iron electrodes serves as source. The objective to be tested is mounted as camera lens, and in front of it is placed a diaphragm with two slits, 6 mm. × 30 mm., and 6 mm. apart, parallel to the spectrograph slit, and to the edge of the prism. Photographs are taken outside the focus, which, owing to the two-slit diaphragm, show all the lines of the iron spectrum double. The positions of the foci for the various colours are determined from measures of these photographs. A. E.

57. *Depth of Definition in the Field of View of the Low-power Telescope.* **F. J. Cheshire.** (British Optical Journ. 3. pp. 65–67, Nov., 1903.)—In free vision the total depth of the field of view which can be seen sharply defined depends upon two optical properties of the eye—focal depth and accommodation power. The former, however, plays a very small *rôle*. The author calculates that, for any given observer, the accommodation power in telescopic vision varies inversely as the square of the magnification. This rapid extinction of the depth of definition is one of the prices one must inevitably pay for the use of the telescope. A. E.

58. *Newton's Scintillation Phenomenon.* **K. Exner** and **W. Villiger.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1265–1311, Oct. and Nov., 1902.)—

Owing to the small irregularities produced in the paths of the rays of light in passing through the atmosphere, the image of a fixed star in a telescope is a disc instead of a point. The reciprocal of the diameter of such a star disc may be taken as a measure of the goodness of seeing (*optisches Vermögen*) at a given place of observation. The paper contains a long list of observations of diameters of star discs made for this purpose with the 10½-in. refractor of the Munich Observatory. It was noted that the scintillation increases with the zenith distance, and that the vertical diameter of a disc appears greater than the horizontal diameter. A. E.

59. *Propagation of Light through Matter.* **C. Puschl.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1151–1160, Oct. and Nov., 1902.)—Assuming that the atoms take part in transmitting light through matter, it is found that, employing Kundt's value, 0·27, for the refractive index of silver, the ratio of the volume of the silver atoms to that of the whole solid is greater than 0·73. Expressions are also obtained for the aberration of light passing through transparent cylinders rotating at high velocity. G. E. A.

60. *Pressure due to Radiation.* **E. F. Nichols** and **G. F. Hull.** (Amer. Acad., Proc. 38. No. 20. pp. 559–599, April, 1903.)—Lebedew in 1900 obtained a qualitative confirmation of the Maxwell-Bartoli theory of this subject [see Abstract No. 1059 (1901)]. The present paper describes protracted experiments conducted with a view to quantitative confirmation. From the agreement, within the probable errors, of the results obtained under various conditions, it appears that the radiation pressure depends only upon the intensity of the radiation and is independent of the wave-length. In designing the apparatus, which is too intricate for description in an Abstract, the following considerations were kept in view: (1) The surfaces which receive the radiation, the pressure of which is to be measured, should be as perfect reflectors as possible. This will reduce the gas action by making the rise of temperature due to absorption small. (2) By studying the action of a beam of constant intensity upon the same surface surrounded by air at different pressures, certain pressures may be found at which the gas action is less than at others. (3) The apparatus—some sort of torsion balance—should carry two equal surfaces symmetrically placed with reference to the rotation axis. The surfaces or vanes should be so constructed that if the forces due to gas action and radiation pressure have the same sign in one case, a reversal of the suspension should reverse the gas action. (4) Radiation pressure, from its nature, must reach its maximum value instantly, while gas action begins at zero and increases, rapidly at first, then more slowly, often for 2½ to 3 minutes. The gas action may thus be reduced by a ballistic method of measurement. The observations were of three different kinds: (*a*) Calibration of the torsion balance; (*b*) measurement of the pressure of radiation in terms of the constant of the balance; (*c*) measurement of the energy of the same beam in erg-seconds by the rate of temperature rise of a blackened silver disc, of known mass and specific heat. To make sure that the observed radiation pressures were uninfluenced by the wave-length of the incident energy, measures were made with a plate of ruby glass, and others with a water cell, placed in the path of the beam. It was noted in the course of the experiments that the reflection from vanes with silver faces was very much higher than for glass faces backed by silver, though the absorption of the unsilvered glass was found to be negligible. A similar difference is recorded by Rayleigh. A. E.

61. *Optical Behaviour of Small Metallic Particles.* **F. Ehrenhaft.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 181–209, Jan.–March, 1903. From the II. Physik. Institut der k.k. Universität in Wien.)—An inquiry was undertaken into the optical behaviour of small suspended metallic particles whose dimensions were small compared with the wave-length of light. The observed facts were examined with reference to the electromagnetic theory of light, and the size of the particles was determined. The behaviour investigated is quite different in the case of insulating particles from what it is when the particles are conductors of electricity. If non-polarised light enters a medium in which small insulating particles are suspended in the path of the beam, then the diffuse reflected light is partially plane-polarised. The theory of Rayleigh gives a maximum of polarisation in all diffuse rays which lie in a surface at right angles to the primary ray. This was established in the case of the cloudy media or the colloid matters in suspension observed by Tyndall. The author's measurements show that in the case of colloidal silicic acid the maximum of polarisation occurs under 90° to the incident beam, with colloidal sulphite of arsenic under 87° 30′. If light is diffusely scattered by conducting spheres whose dimensions are small compared with the wave-length of light, then in accordance with a theoretical investigation of J. J. Thomson, the rays of strongest polarisation extend along a conical surface whose axis is in the direction of propagation of the incident beam and whose half vertical angle is 120°. Experiment shows that for metallic colloids examined by Bredig's method this theory holds good. The diffusely reflected light is partially plane-polarised, the maximum of polarisation lies between 118° and 120° in the case of colloidal gold; for colloidal silver about 110°; for colloidal copper about 120°; and for colloidal platinum about 115° to the incident beam. From the agreement of the results of the theory the correctness of the preliminary suppositions may be inferred. These metallic particles appear to be conductors of electricity as regards the rapidly alternating currents which occur in light waves. The investigation of the absorption spectra of the metallic colloids shows in the case of colloidal gold of red colour a broad absorption band about $\lambda = 520\,\mu\mu$, with colloidal platinum about $\lambda = 480\,\mu\mu$, with colloidal silver in the ultra-violet at $\lambda = 380\,\mu\mu$. The metallic particles embedded in the dielectric will be set in vibration by the light waves arriving from the outside. The period of oscillation of the incident radiation and that of the internal particles will agree. From this optical resonance it is possible to determine the mean size of the particles. The radius of the sphere in which the electromagnetic vibration goes on is in the case of gold from 49 to 52×10^{-7} cm., in that of silver 38×10^{-7} cm., and in that of platinum 48×10^{-7} cm. These magnitudes fall within the limits required by J. J. Thomson's theory. J. J. S.

62. *Reflecting Power and Electrical Conductivity of Metals.* **E. Hagen** and **H. Rubens.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 13. pp. 269–277, March 5, 1903. Communication from the Physikalisch-Technische Reichsanstalt.)—Further experiments on the reflecting power of metals bring out that this property, whilst subject to considerable variation in the ultra-violet and visible parts of the spectrum, varies in a simple manner in the infra-red for all metals and alloys. In all cases the curve for reflecting power (R) and wave-length asymptotically approaches the value R = 100 per cent. The quantity $(100 - R)\sqrt{\kappa}$ is constant, κ being the electrical conductivity, and the average value found was 11·1. By assuming that the vibration of the molecule has no influence on long waves, it was found by Planck that

$R_1 = 1 - 2\sqrt{wn}$, where $R_1 = R/100$, w is the ohmic resistance of the metal in absolute electrostatic units, and n, the frequency of the vibrations, $= 2{\cdot}5 \times 10^{13}$. From this, the value of the above constant comes out as 10·2. Maxwell's theory thus receives confirmation in a new region. The conclusion is also drawn that the magnetism of iron and nickel cannot be induced by means of a frequency of $2{\cdot}5 \times 10^{13}$. [See also Abstract No. 1049 (1902).]

G. E. A.

63. *Optical Properties of Metals for Long Waves.* **M. Planck.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 13. pp. 278–280, March 5, 1903.)—The expressions employed by Hagen and Rubens [see preceding Abstract] are deduced, viz., the light extinction coefficient $= \sqrt{\Lambda\tau}$, where Λ is the electrical conductivity of the metal in abs. electrostatic measure, and τ the period of a light vibration; R_1, the reflection coefficient, $= 1 - 2/\sqrt{\Lambda\tau}$.

G. E. A.

64. *Emissivity of Metals for Long Waves.* **E. Hagen** and **H. Rubens.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 19. pp. 410–419, April 2, 1903. Communication from the Physikalisch-Technische Reichsanstalt.)—The formula deduced by Planck, viz. $(100 - R)\sqrt{\kappa} =$ constant, where R is reflecting power and κ conductivity [see two preceding Abstracts], has already been given by Drude in "Physik des Aethers," p. 574, equation No. 66. The present experiments to test the formula show that the emissivity $(100 - R)$ of metals for long waves is inversely proportional to $\sqrt{\text{electrical conductivity}}$ and depends on the temperature as Maxwell's theory requires. The extinction coefficient and the refractive index for normal incidence are numerically equal $(= 5{\cdot}48\sqrt{\kappa\lambda})$. Another remarkable result is that by dividing the emissivity (that of black body = 100) by the above constant, and squaring the quotient, the resistance in ohms of a wire of the material 1 m. long and 1 sq. mm. in section is obtained. [See also Abstract No. 1049 (1902).]

G. E. A.

65. *Emission and Absorption Power of Metals for Great Wave-lengths.* **H. A. Lorentz.** (Konink. Akad. Wetensch. Amsterdam, Versl. 11. pp. 787–807, April 24, 1903.)—Hagen and Rubens have shown by their recent researches on the reflecting power of metals, that the properties of these bodies for rays of great wave-lengths may be accounted for, when describing the propagation of electric oscillations, by means of the equations of slowly variable currents, which comprise no physical constants of the metal beyond the conductive power [see Abstract No. 1049 (1902)]. This shows the principles of the theory of electrons to be sufficient also to afford a satisfactory idea of the absorption of rays. In this paper the author examines the question as to whether, in the case of great wave-lengths, the emission of a metal can as well be accounted for on the hypothesis that the emission includes electrons flying to and fro in the same wave, with proper vibrations of definite period. This is shown to be the case, the emissive power of metals being calculated on the above hypothesis, and the ratio of this to the absorption power determined. The ratio proves to be independent of the quantity by which one metal differs from the other. [See also Abstract No. 62 (1904) and preceding Abstract.]

A. G.

66. *Actinic Power of Magnesium, Aluminium and Phosphorus Flames.* **J. M. Eder.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 249–260, April–June, 1903.)—A magnesium strip, burned in a clockwork lamp, gave an optical illumination of 135 Hefner-candles when burning at the rate of 7·4 milligrammes per second. The chemical effect of the light was measured by comparison with that of the standard lamp. The loss of power when the light passed through colourless glass was measured, and the increase of candle-power when the combustion takes place in oxygen was determined in each case. This latter is particularly noticeable in the case of aluminium, the photographic action being increased about sixtyfold. J. E.-M.

67. *Refraction of Light in the Chromosphere.* **A. Schmidt.** (Phys. Zeitschr. 4. pp. 341–348, March 15, 1903.)—This paper is a continuation of a previous paper [see Abstract No. 1340 (1903)] and describes the calculation of the indices of refraction for the various spectral regions to a second degree of approximation. E. C. C. B.

68. *Magnetic and Electric Dichroism of Liquids.* **G. Meslin.** (Comptes Rendus, 136. pp. 888–889, April 6, and pp. 930–932, April 14, 1903.)—The author discovered that liquids in a magnetic field may show dichroism, *i.e.*, unequal absorption of two component light-rays which vibrate parallel and perpendicular to the magnetic field. Liquids such as carbon disulphide, turpentine, benzine, chloride of tin, holding in suspension small particles of such substances as bichromate of potassium, copper sulphate, &c., show this effect. The nature of the liquid, and that of the solid substance, and finally the grouping of the two bodies, all have a very active influence on the intensity of the phenomenon. The effect may be produced in two ways, and may be characterised by a sign: the most absorbed vibration may be that which is parallel to the field, or that perpendicular to the field. The first case is called by the author *positive* dichroism, the latter is called *negative* dichroism. Thus, copper sulphate in carbon disulphide gives positive dichroism, while in French turpentine it gives negative dichroism; bichromate of potassium, again, gives negative dichroism with each of these liquids. The author gives in two columns—one for positive, the other for negative dichroism—various groupings of substances which produce the effect named at the head of the column. Experiments were also made to find if an electric field produced an analogous effect. The author found it only in one case, which gave negative dichroism, while the same group in the magnetic field gave positive dichroism. W. C. H.

69. *Magnetic Rotation in Selective Absorbing Media.* **A. Schmauss.** (Ann. d. Physik, 10. 4. pp. 853–862, March, 1903. From the Berichten der Kgl. Bayer. Akademie, Nov. 8, 1902.)—The anomalous rotation of liquid oxygen in a magnetic field is measured, the numbers for water being given for comparison. On passing from the gaseous to the liquid state the rotation in oxygen increases at a greater rate than does the density, viz., about 1 : 900. In the negative rotating solutions of neodymium, praseodymium, and erbium nitrates the anomalies of rotation due to selective absorption are positive—positive here meaning the anomalous course of rotation in positively rotating absorbing media. [See also Abstract No. 54 (1903).] G. E. A.

70. *Errors in ruling Diffraction Gratings.* **H. S. Allen.** (Phil. Mag. 6. pp. 559–562, Nov., 1903.)—The bands due to errors in ruling a grating [see Abstract No. 1059 (1902)] are employed in locating the errors in the Blythswood dividing engine and in determining the correction required to eliminate

the residual periodic error arising from the ratchet wheel and thrust block. Photographs of a grating made by the engine are given, and a curious case of interference bands produced by a grating is described. G. E. A.

71. *Ruling Errors in Grating Spectra.* **A. S. King.** (Astrophys. Journ. 17. pp. 239–242, April, 1903.)—As long as the ghosts of bright lines are symmetrically distributed with respect to the primary line and close to it, they may easily be recognised. Certain gratings, however, will give high order ghosts which are sufficiently bright and sufficiently removed from the primary line to be easily mistaken for real spectrum lines. The fundamental formulæ, as found by Rowland, give for the position of the μth order ghost $\mu_n = \frac{2\pi N}{ba_0} \pm \frac{ne_1}{ba_0}$, and for the intensity $I = J_n(b\mu_n a_1)$, where the first term of μ_n gives the position of the primary line, and the second term the position of the ghost with respect to the primary line. N denotes the order of spectrum of the primary line, a_0 the grating space, a_1 and e_1 the amplitude and period of the ruling error, and $b = 2\pi/\lambda$. Certain characteristics of ghosts are given by the above formulæ, but the author has obtained ghosts which do not obey these relations. For example, it is evident that the two ghosts of the same order on each side of the primary line should have the same intensities, and, further, in the case of the ghosts from one primary line, the intensity of the first-order ghosts should be the greatest, and the intensity should rapidly decrease as the order number of the ghost increases. The author has found that with a particular grating the ghosts of the same order have not the same intensity on each side of the primary line; also in the case of the band at $\lambda = 3883$ the ghosts of the first four orders were found at $\lambda = 3888{\cdot}75$, $3893{\cdot}90$, $3899{\cdot}06$, and $3904{\cdot}22$, and their intensities were in the ratio of 10, 5, 2, and 8. It is evident that the fourth-order ghost might have been mistaken for a real spectral image. Fortunately, however, the distance of a ghost from the primary line varies with λ, but is independent of the order of spectrum of the primary line. Ghosts may thus be readily distinguished from real lines by observing the primary lines in different orders. E. C. C. B.

72. *Theory of Spectral Series.* **W. Ritz.** (Phys. Zeitschr. 4. pp. 406–408, April 15, 1903.)—This interesting paper is an abstract of the author's inaugural dissertation, and only gives very briefly the lines of the investigation. Starting with Rydberg's equations for the series of hydrogen lines—

$$\pm r = N\left(\frac{1}{n^2} - \frac{1}{m^2}\right) \text{ and } \pm r = N\left(\frac{1}{n^2} - \frac{1}{(m + \frac{1}{2})^2}\right)$$

the author arrives at the general equation for all substances, which give spectral series, $\pm r = N\left(\frac{1}{p^2} - \frac{1}{q^2}\right)$, where p and q are the roots of certain transcendental equations. These terms can be expressed in semi-convergent series of the form $p = m + \alpha + \frac{\beta}{m^2} + \frac{\gamma}{m^4} + \ldots$ $q = n + \alpha' + \frac{\beta'}{n^2} + \frac{\gamma'}{n^4} + \ldots$ The coefficient N is thus absolutely the same for all substances. [It will be remembered that Rydberg has always insisted on this point.] If the formula be taken with only the first two terms of the above series, then we have $\pm r = N\left(\frac{1}{(m + \alpha)^2} - \frac{1}{(n + \alpha')^2}\right)$, which shows that Rydberg's formula is a first approximation. Also it is clear that Rydberg's formula must be corrected for the lower values of *m* and *n* by including more terms of the above series, and not by altering the value of N. As a second approximation for a single series ($n =$ const.), giving N Rydberg's value of 109675·00 we have

$$\pm r = \mathrm{A} - \frac{109675{\cdot}00}{\left(m + \alpha + \frac{\beta}{m^2}\right)^2},$$

where $m = 1, 2, 3 \ldots$ This formula when applied to sodium and potassium and several other elements, gives very strikingly accurate results even for the lowest values of *m*. The connection insisted upon by Rydberg between the second subordinate series and the principal series is in this way mathematically proved, and the two can be combined in one formula. The doublets of these two series in the spectra of all the alkali metals are given by the formulæ—

$$\pm r = \mathrm{N}\left\{\frac{1}{\left(n + a_1 + \frac{\beta}{n^2}\right)^2} - \frac{1}{\left(m + 0{\cdot}5 + a' + \frac{\beta'}{(m + 0{\cdot}5)^2}\right)^2}\right\}$$

$$\pm r = \mathrm{N}\left\{\frac{1}{\left(n + a_2 + \frac{b}{n^2}\right)^2} - \frac{1}{\left(m + 0{\cdot}5 + a' + \frac{\beta'}{(m + 0{\cdot}5)^2}\right)^2}\right\}$$

The differences between the measurements and calculated values for the sodium and potassium spectra are given in the paper and are exceedingly small, being of the order of 0·05 to 0·2 A.U. even for the red lines.

[The differences between the values obtained by Kayser and Runge and the measurements, vary from 78 to 334 units for the lower members of these series. It appears from this very condensed paper that the author has made a very great advance in our knowledge of spectral series. Perhaps the most interesting point he has proved is the general constancy of the term μ in Rydberg's formula; this formula is $r = \mathrm{A} - \frac{\mathrm{N}}{(m + \mu)^2}$, where μ for hydrogen is equal to 1 and 0·5 respectively for the two series, but differ for other substances; the author, however, shows that μ is a general constant (1 or 0·5 for the two series) and that the series in other spectra are expressed not by changing μ but by the introduction of other constants. Rydberg has always claimed that his formula was only a first approximation, as the author has now shown it to be.] E. C. C. B.

73. *Vessels of Quartz and of Glass.* **J. Trowbridge.** (Elect. Rev. N.Y. 43. p. 682, Nov. 14, 1903.)—In experimenting with gases at very high temperatures our only method consists in sending electric discharges through the gases enclosed in vessels of quartz or of Jena glass. It is found that Jena glass cannot be fused on to other kinds of glass, but may be readily fused with platinum in the oxyhydrogen flame; quartz can be fused neither to glass nor to platinum. At temperatures *above* that at which there appear the boron spectral lines with glass vessels or the silica lines with quartz vessels enclosing gases, we get a *continuous* spectrum which is not due to luminescence of the glass or quartz. Hence we must be careful in inferring the absence of gas in a star which gives a continuous spectrum devoid of lines. D. H. J.

74. *Spectra of Neon, Krypton, and Xenon.* **E. C. C. Baly.** (Roy. Soc., Phil. Trans. 202. pp. 183–242, Nov. 11, 1903.)—The measures for the long list of spectrum lines given in this paper were made from photographs taken with a large Rowland grating (14,438 lines to the inch; focal length 10 ft.), the probable error being estimated at less than ±0·08 Ångström unit. The spectra of the gases all consist of bright well-defined lines similar to those of argon and helium. The most striking is the spectrum of neon, which consists almost entirely of very bright lines in the orange and red regions; the colour of the electric discharge through the gas is a magnificent orange. When a Leyden jar and a spark-gap are placed in the circuit, no decided change takes place in either the appearance or the spectrum of the discharge. Krypton and xenon, on the other hand, resemble argon in possessing two spectra, one being obtained when the direct discharge is passed, and the other when a Leyden jar and spark-gap are placed in the circuit, the latter being much the more complex. The distinctness of the spectrum and the definition of the lines depend upon the pressure of the gas in the vacuum tube. If this pressure exceeds a certain small amount, the spectrum becomes confused and at times almost continuous. If the pressure is then slowly reduced, the lines begin to appear upon a more or less continuous background, and, gradually increasing in brightness, finally become sharply defined upon a black background, but the lines do not all become equally sharp at once. As regards former measures by other observers, Runge was unaware of the existence of xenon, and hence certain lines belonging to this gas are to be found in his list of krypton lines [see Abstract No. 54 (1900)] A table is given of lines which must be deleted from the blue spectrum of argon in Kayser's and Eder and Valenta's lists. Three of these lines belong to krypton. It is curious that only three of the weakest krypton lines should be visible in the argon spectra; no trace of the stronger lines could be detected. A table of new lines found in the blue spectrum of argon is also given. An interesting fact is the existence of a number of weak lines common to the jar and spark spectra of krypton and xenon. They may belong to either, or may be due to some common impurity, possibly a still heavier element of the same family. A great number of xenon and krypton lines which do not appear in Liveing and Dewar's lists have been measured. Liveing and Dewar's list of lines of the most volatile constituents of the atmosphere [see Abstracts Nos. 1625 and 2197 (1901)] contains several of unknown origin which the author finds are not due to neon. The extraordinary heating of the electrodes of the vacuum tube during electric discharge forms a source of annoyance in working with these monatomic gases, owing to the great quantity of hydrogen evolved. Another trouble is the shortening of the life of the tube on account of volatilisation of the aluminium parts. A. E.

75. *Effect of Pressure upon Arc Spectra.* **J. E. Petavel and R. S. Hutton.** (Phil. Mag. 6. pp. 569–577, Nov., 1903.)—This paper gives the results of some preliminary experiments upon the photography of certain arc spectra under great pressures. The apparatus employed was capable of withstanding a pressure of 450 atmospheres, and both alternating and continuous currents were employed. In the case of the carbon arc, when the distance between the electrodes was not great, no difference was observed from the ordinary arc spectrum; when the electrodes were separated as far as possible, the carbon bands appeared, and the cyanogen bands at λ = 3883 were reversed. Small quantities of hydrogen were admitted, and then this reversal took place easily at 16 atmospheres

pressure. The calcium lines were present and generally reversed; the line at λ = 4226 was more strongly evident than the H and K lines, and in certain cases the 4226 line was strongly reversed and the H and K lines not visible at all. In the case of iron at 44 atmospheres pressure many lines above λ = 3800 were strongly reversed. Observations were also taken of the iron glow spectrum, that is to say, the spectrum of the iron arc under reduced pressures. This spectrum is very much simpler than the ordinary arc spectrum, for whereas a small number of the iron hues retain their intensity unimpaired, the greater number are considerably diminished or are altogether absent. The wave-lengths of the lines observed between the limits λ = 5456 and λ = 3581 are given. E. C. C. B.

76. *Distribution of Intensity in Line Spectra.* **K. Langenbach.** (Ann. d. Physik, 10. 4. pp. 789–815, March, 1903. Extract from Inaugural Dissertation.)—An account is given of the results of an inquiry in what way the distribution of intensity under the lines of a series varies. Observations were made on Geissler tubes containing hydrogen, helium, and lithium. The measurements were made by means of a Glan's photometer, and a glow lamp served as a means of comparison, the current through the lamp being kept constant, or varied if desired. The connection between energy and pressure was first investigated. Experiments were also made on the influence of self-induction, of elongation of the spark, and of capacity. The question of the possibility of obtaining some knowledge of the temperature of the fixed stars and nebulæ is discussed. J. J. S.

77. *Gaseous Constitution of the H and K Lines of the Solar Spectrum, and the Reversal of Gaseous Lines.* **J. Trowbridge.** (Amer. Journ. Sci. 15. pp. 243–248, April, 1903. Phil. Mag. 5. pp. 524–529, May, 1903.)—In previous papers the author has described the spectra produced by the passage of a very powerful condenser discharge through Geissler tubes, and he noted the presence of two lines closely conciding with certain calcium lines. After a series of experiments with quartz vacuum tubes and various electrodes, it appears absolutely certain that these two lines are not due to calcium at all, but to some gas. In cases where they are visible, the neighbouring calcium lines are not visible, and, further, they are produced with quartz tubes, and in other cases where it is clear no calcium is present. The author is inclined to attribute the lines to oxygen. [See also Abstracts Nos. 56 and 1181 (1903).] E. C. C. B.

78. *Measurements of the Band Spectrum of Nitrogen.* **P. Hermesdorf.** (Ann. d. Physik, 11. 1. pp. 161–169, April, 1903. Extract from Bonn Dissertation.)—Measurements are given of the lines in the band spectrum of nitrogen between the limits λ = 3998·470 and λ = 3338·83 obtained with the help of gratings, with a probable error of ± 0·01 A.U. The author tests the validity of Deslandres' three laws and finds that they are not absolutely true, but that they give fair approximations. E. C. C. B.

79. *Maxima and Minima of Luminous Intensity within Broadenings of Spectral Lines.* **W. H. Julius.** (Konink. Akad. Wetensch. Amsterdam, Versl. 11. pp. 767–771, April 24, 1903.)—Holding that the main cause of the broadening of Fraunhofer lines is not the absorption but the anomalous dispersion of the wave-lengths located in the spectrum on both sides of the

central absorption line, the author gives an explanation of the following fact observed by Jewell and Hale: On a plate, those Frauenhofer lines most broadened turned out to be dissolved in a system of feeble, indistinct lines, symmetrically situated on both sides of the central absorption line, the mutual distances of the luminous minima increasing for increasing distances of the latter from the central line. This phenomenon is imitated in the absorption spectrum of sodium vapour. The above is a further instance of the author's statement that numerous peculiarities of the solar spectrum may be explained as due to anomalous dispersion. [See also Abstracts Nos. 25, 880 and 881 (1903).] A. G.

80. *Double Refraction in the Magnetic Field in the Neighbourhood of the Components of a Quadruplet.* **P. Zeeman** and **J. Geest.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 23–25, May 30, 1903.)—In a former paper the author gave the results of investigations into the magnetic rotation of the plane of polarisation in sodium vapour in the immediate neighbourhood of the absorption line, when the rotation turned out to be positive in very diluted vapour outside of the components of the doublet produced from the original spectral line by magnetic forces, whereas very high negative values were found between the components, where the light evidently traversed the vapour in the direction of the flux [see Abstract No. 1842 (1902)]. The present work was undertaken with a view to ascertaining the phenomena observed in gradually passing from extremely small vapour densities to higher values of the latter; extremely dilute vapour densities were exclusively dealt with in the neighbourhood of the D_1 line, which was separated by a magnetic field into four components. Fig. 1 represents the general aspect of the phenomena observed by the author, whereas the theoretical behaviour is shown by Fig. 2, prepared from Voigt's results [see Abstract No. 1843 (1902)]. The accord in the region intermediate between the two central components of the quadruplet is most important and is taken as a confirmation of the theory. A. G.

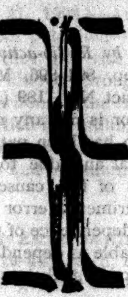


Fig. 1.

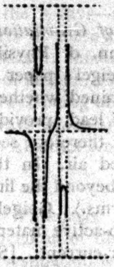


Fig. 2.

81. *Light and Uranium Nitrate.* **J. Härdén.** (Phys. Zeitschr. 4. pp. 306–307, March 1, 1903.)—Crystals of uranium nitrate shaken in a glass tube give off a yellowish-green shimmering light. In a tube containing air at ordinary pressures they enable the air to act like the rarefied gas in a Geissler tube; but the light produced has no photographic and no fluorescence-exciting power when a dark card intervenes. An ordinary induction-coil brings out this effect much better than a Tesla coil. A magnetic field does not induce luminescence. A. D.

82. *Röntgen-ray Duration.* **F. H. Glew.** (Roentgen Ray, Archives. 7. pp. 110–112; Discussion, p. 112, April, 1903.)—The author by photographic methods, using a vibrating lens, showed spark phenomena and brought out that the emission of Röntgen rays is discontinuous, a succession of maximum impulses each waning away to nothing through a series of oscillations. The intervals between the series of pulses are relatively very long, say 95 per cent. of the whole time. The photographic effect would probably be greatly increased for a given quantity of Röntgen ray energy if the emission could be made continuous. A. D.

83. *Absorption of Gravitational Energy by Radio-active Bodies.* **C. Forch.** (Phys. Zeitschr. 4. pp. 318–319, March 1, 1903.)—In reference to Geigel's observation that radio-active bodies when under a balance pan seem to lessen the weight of the pan [see Abstract No. 1189 (1903)], the author changes the conditions of the experiment and finds a similar effect though different in amount. P. E. S.

84. *Absorption of Gravitational Energy by Radio-active Substances.* **W. Kaufmann.** (Ann. d. Physik, 10. 4. pp. 894–896, March, 1903.)—The author refers to Geigel's paper [see Abstract No. 1189 (1903)]. The same results can be obtained whether there is or is not any radium in the dish under the mass of lead, provided the dish has been put in place with the fingers; the effect therefore seems thermal and due to feeble ascending currents of warmed air. In the absence of this cause, radium chloride produces no effect beyond the limits of experimental error (equally + and —, 0·0005 mg. on 10 grms.). Geigel's alleged dependence of the effect upon the breadth of the radio-active material is explicable as depending on the breadth of the ascending air-current. [See also preceding Abstract.] A. D.

85. *Emanation from Phosphorus.* **G. C. Schmidt.** (Ann. d. Physik, 10. 4. pp. 704–729, March, 1903.)—Referring to his former account of experiments on this subject [see Abstract No. 85 (1903)] and to the criticisms of Harms [see Abstract No. 821 (1903)], the author here describes extended observations from which he deduces the following conclusions: For the appearance of ions or electrons in the case of the slow oxidation of phosphorus no example has hitherto been brought forward. The conductivity arising through the oxidation of phosphorus is only an apparent one, which is caused by the convection of electricity by means of solid, fog-like, conducting products of oxidation. The conducting particles are the phosphorous acids. J. J. S.

86. *Induced Radio-activity due to Actinium.* **A. Debierne.** (Comptes Rendus, 136. pp. 671–673, March 16, 1903.)—Referring to the behaviour of actinium, the author here notes that the action takes place as if the activation was produced by a peculiar radiation sent out by each of the centres of energy (emanation), the activation of a layer placed in an enclosure with actinium being proportional to the total flux of radiation that it absorbs. The author's experiments appear to indicate that there exists a new radiation

characterised essentially by the property of temporarily rendering radio-active the bodies on which it strikes. This "activating radiation" proceeds from activating centres within the gas in the neighbourhood of the actinium. The new rays can be deviated by a magnetic field and by an electric field, the deviation being such as would occur in the case of positively charged particles animated with a high velocity. J. J. S.

87. *The Mystery of Radium.* **W. Crookes.** (Chem. News, 87. p. 158, April 3, 1903.)—This is a reprint of a letter to the *Times* in which the author suggests that the continuous maintenance of a higher temperature than its surroundings on the part of radium may be due to an atomic structure of such radio-active bodies which enables them to throw off the slow-moving molecules of the air with little exchange of energy, while the quick-moving missiles may be arrested with their energy reduced and that of the target correspondingly increased. Thus radium might possibly draw upon the kinetic energy stored in the molecular motions of ordinary air in a way somewhat analogous to that of Maxwell's sorting demons. J. J. S.

88. *Polonium Radiation.* **H. Becquerel.** (Comptes Rendus, 136. pp. 977–982, April 27, 1903.)—An account of recent experiments on the penetrating rays from polonium—other than the X-rays—and the secondary radiation to which they give rise. The effects of these rays are similar to those from radium filtered through a considerable thickness of metal. Of the three distinct portions of the radiation from radium, polonium appears to possess two, the portion resembling cathode rays being absent. The author considers that uranium radiation contains no rays which are analogous to the X-rays from radium and polonium. [See also Abstract No. 1871 (1903).] J. J. S.

89. *Radio-activity Excited in Air at the foot of Waterfalls.* **J. C. McLennan.** (Phil. Mag. 5. pp. 419–428, April, 1903.)—An account of observations made at Niagara Falls. The general result of the investigation was that during the course of the experiments the amount of radio-activity induced in a wire exposed at the foot of the falls was found to be very much less than that in a wire exposed in the same manner in Toronto. J. J. S.

90. *Charge on the Ions produced in Air by Röntgen Rays.* **H. A. Wilson.** (Phil. Mag. 5. pp. 429–441, April, 1903.)—The charge on one ion—e—was determined by a method depending on the fact that the ions produced in air by Röntgen rays act as nuclei for the cloudy condensation of water-vapour when supersaturation exceeding a definite amount is produced by a sudden expansion. The mean result of the experiments gives the value $e = 3{\cdot}1 \times 10^{-10}$ of an electrostatic unit. J. J. S.

91. *Radio-activity of Radium and Thorium.* **E. Rutherford** and **F. Soddy.** (Phil. Mag. 5. pp. 445–457, April, 1903.)—This paper gives a comparative study of the radio-active properties of thorium and radium. These properties are closely allied, though there is a great difference in their relative activity. The occlusion of the emanations is considered, and the influence of the emanation on the radio-activity of radium. The rate of decay of radium emanations and the recovery of radium activity are expressed by means of curves. Radium, like thorium and uranium, emits two types of

radiation, the α, easily absorbed, and only deflectible in very intense magnetic fields, and the β, or penetrating rays, readily deviated in a magnetic field. It also emits some very penetrating rays not yet fully investigated. The X-rays are the first to be produced, the β-rays only resulting in the last stages of the process that can be experimentally traced. J. J. S.

92. *Influence of Radium on the Growth of Embryos.* **G. Bohn.** (Comptes Rendus, 136. pp. 1012–1013, April 27, 1903.)—Embryos of toads and frogs are exposed to the radiations from radium bromide for from three to six hours. The growth of toad embryos, which is normally slow, is inhibited. Frog embryos eight days old, rapidly change into tadpoles, but become deformed in various ways. Younger individuals at first appear uninfluenced by the rays, but when they develop into tadpoles, they show similar deformities. A few of the embryos die almost immediately after this treatment.

H. W. P. Y.

93. *Radium Emanations.* **W. Crookes.** (Roy. Soc., Proc. 71, pp. 405–408, April 30; Chem. News, 87. p. 241, May 22, 1903).—An account of the bright scintillations observed on a screen of Sidot's hexagonal blende (zinc sulphide) when a minute portion of crystalline radium nitrate was brought near it. Many flashes of light per second appear on the screen, and these are best seen with a pocket lens magnifying about 20 diameters. The appearance is better with a zinc sulphide screen than with one of barium platinocyanide. The author suggests that the effect is due to a bombardment of electrons thrown out by the radium with a velocity of the order of that of light. J. J. S.

94. *Energy Emitted by Radio-active Bodies.* **R. J. Strutt.** (Nature, 68. p. 6, May 7, 1903.)—The author points out the importance of determining whether radium, as contained in pitchblende, emits as much energy as the same amount of the material in the form of an artificially concentrated product. The mineral has probably been liberating energy at not less than its present rate for a period of time comparable with the age of the earth. The author estimates that at the centre of an infinite slab of pitchblende one metre thick, the temperature would exceed that at the faces by about a fifth of a degree, so that the effect could probably be measured experimentally. W. S.

95. *Radio-active Change.* **E. Rutherford** and **F. Soddy.** (Phil. Mag. 5. pp. 561–576, May, 1903.)—The emanations from radium and from thorium were passed through tubes cooled by means of liquid air. Both emanations were condensed. The suddenness of the volatilisation of the radium emanation is very remarkable considering the minute quantity of matter involved. In the case of thorium the temperature of volatilisation and condensation is −120°. The temperature of initial volatilisation of the radium emanation is −150°, and there is no sensible difference between the temperatures of volatilisation and condensation. The condensed emanations possess a true vapour pressure and the usual properties of gaseous matter. That they consist of matter in the gaseous state is shown by the experiments here described taken along with their previously proved behaviour as to diffusion and their occlusion by solids. J. J. S.

96. *Radio-active Change.* **E. Rutherford** and **F. Soddy.** (Phil. Mag. 5. pp. 576–591, May, 1903.)—This paper treats of (1) the products of radio-active

change and their specific material nature, (2) the synchronism between the change and the radiation, (3) the material nature of the radiations, (4) the law of radio-active change, (5) the conservation of radio-activity, (6) the relation of radio-active change to chemical change, (7) the energy of radio-active change and the internal energy of the chemical atom. It is not possible to regard radio-activity as a consequence of changes that have already taken place. The rays emitted must be an accompaniment of the change of the radiating system into the one next produced. It is suggested that helium may be one of the ultimate products of radio-active change. It is calculated that in the case of uranium and thorium out of one gram less than a milligram would change in a million years. In the case of radium the same amount must be changing per gram per year. This would give for the "life" of radium a few thousand years. With regard to solar energy, its maintenance could be accounted for if processes of sub-atomic change are going on, and the internal energy of the component elements can be considered to be available. [See also preceding Abstract.] J. J. S.

97. *Action of Ultra-violet Light on Rare-earth Oxides.* **C. Baskerville.** (Chem. News, 88. pp. 263–264, Nov. 27, 1903.)—Out of seventeen rare-earth oxides only two responded to the action of violet light from a Piffard lamp, viz., zirconium and thorium dioxides. The thorium dioxide remained luminous in the dark for a greater length of time, and the zirconium dioxide showed no radio-activity. Twenty minerals containing the above two compounds exhibited neither fluorescence nor phosphorescence under the action of ultra-violet light. G. E. A.

98. *Radio-active Lead.* **K. A. Hofmann** and **V. Wölfl.** (Chem. News, 87. pp. 241–243, May 22, 1903. From the Ber. Deut. Chem. Gesell. 36. p. 1040, 1903.)—An account of the chemical behaviour and radio-active properties of lead obtained from pitchblende. There exists a substance, analytically closely allied to ordinary inactive lead, but separable from it, which is very strongly primarily active and produces both α- and β-activity, and hence can act strongly on other metals by induction, whether these are kept as salts in the same solution as the radio-lead chloride, or whether, as clean chemically unaltered fragments, they are exposed to the influence of the primary agent. J. J. S.

99. *Radio-activity of Water.* **E. P. Adams.** (Phil. Mag. 6. pp. 563–569, Nov., 1903.)—The author describes experiments made to determine the nature of the radio-active gas found in Cambridge tap-water by J. J. Thomson. He concludes that the water radio-activity is due to a substance very similar to, if not identical with the emanation of radium, which is dissolved in the water. As there is no indication of a sufficient amount of an emanating substance present in the water, the greater part of the emanation must be supposed due to radio-active emanating substances distributed near the source of the water. W. S.

100. *Radio-active Thorium.* **K. A. Hofmann** and **F. Zerban.** (Chem. News, 88. pp. 226–227, Nov. 6, 1903. Ber. Deut. Chem. Gesell. 36. p. 3093, 1903.)—Recent experiments have confirmed the conclusion that freshly-made thorium preparations are strongly radio-active to different degrees according to the amount of uranium contained in the mineral. Pure thorium and its compounds possess in themselves no primary activity, inactive thorium earth

having been obtained from orthite, yttrotitanite and gadolinite, the oxide from the latter mineral being unable to affect a photographic plate through thin black paper in twenty-four hours. The gadolinite had the property of suddenly glowing throughout its whole mass on heating. The mode of preparation and the reactions of Debierne's actinium are described, preparations of which did not diminish in activity during a year. [See also Abstract No. 1064 (1902).] G. E. A.

101. *Heating Effect of the Radium Emanation.* **A. Schuster.** (Nature, 69. p. 55, Nov. 19, 1903.)—By allowing air charged with radium emanations to fall upon a thermo-electric junction, the author ascertained that the emanations caused a heating effect which did not reach a maximum till after thirty minutes. Rutherford has shown that the excited activity contains three successive stages of radio-active matter, the first changing into the second, and the second into the third; the existence of the above considerable interval before the maximum heating effect, indicates that the heat is set free at a late or final transformation. D. H. J.

102. *Radium and Animals.* **E. G. Willcock.** (Nature, 69. p. 55, Nov. 19, 1903.)—The author has exposed animals of simple structure to radium-rays with a view to determine (*a*) whether the rays would cause an immediate contraction; (*b*) whether they would repel or attract animals bodily. Under (*a*) it was found that actinosphærium, with pseudopodia extended, did not retract its pseudopodia when exposed in daylight to 10 mgm. of radium at 8 mm. distance. In two hours, however, it was dead and breaking-up; controls were unchanged. *Stentor* contracted when exposed to radium emanations. Under (*b*) it was shown that *Stentor* and *Hydra* (both viridis and fusca) moved bodily out of the path of β-rays; weak specimens were killed. Encysted specimens of *Euglena viridis* become motile under the influence of β- and γ-rays, and disperse without suffering any harm. D. H. J.

103. *Luminous Radiation of Radium.* **W. Huggins** and **Lady Huggins.** (Roy. Soc., Proc. 72. pp. 409–413, Nov. 21, 1903.)—Further observations on the spectrum of the spontaneous luminous radiation of radium at ordinary temperatures are described. The spectrum of the aureole about the negative glow of a vacuum tube containing a residuum of atmospheric nitrogen, agrees with the nitrogen spectrum obtained from the radium glow. The heads of the two strongest bands in the photographic region in the first-mentioned spectrum occur at the positions of the two outstanding lines of the radium-glow spectrum. No traces of the spectrum of bromine or of radium were obtained. No helium spectrum was obtained, though carefully looked for. The stimulation sent out by radium, which produces the results, may be of a kind which is unable to elicit from the molecules of bromine or of radium their characteristic line spectra. It is possible that the same inability may hold in respect of the helium molecule. J. J. S.

104. *Sensation of Light Produced by Radium Rays.* **W. B. Hardy** and **H. K. Anderson.** (Roy. Soc., Proc. 72. pp. 393–398, Nov. 21, 1903.)—The sensation of diffuse luminosity produced in the eye by radium-rays from which the luminous part has been cut off is due to the β- and γ-rays, and not only do the different parts of the eye glow under their action, but also the other tissues, as skin, fat, and muscle. The glow in the eye is due chiefly to

the β-rays, to which the eyelid is opaque, and which do not penetrate the open eye as far as the retina. A table of the relative transparencies of the different parts of the eye is given, the eyelid having, for instance, a screening action equal to that of 0·4 mm. thickness of lead. The rays have no bleaching action on the visual purple of the frog or rabbit. G. E. A.

REFERENCES.

105. *Projection of Bodies by the Lantern.* **W. Haensch.** (Zeitschr. Instrumentenk., Beib. 5. pp. 33–35, March 1, and 6. pp. 45–47, March 15, 1903.)—Complete details of a perfected apparatus for projecting transparent and opaque bodies on to a screen. P. E. S.

106. *Progress in Photographic Portraiture.* **H. Farmer.** (Photographic Journ. 43. pp. 132–143, May, 1903.)—An account of improvements effected by the use of Farmer arc lamps (long arc, high actinism, low luminosity) and the complete exclusion of blue and ultra-violet rays from the plate by means of colour filters. The exposures are then constant, and the portrait is as the eye sees the sitter. Under a Cooper-Hewitt lamp persons appear to the eye as ordinary photography will represent them. A. D.

107. *Theory of the Sextant.* **L. Weinek.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1319–1330, Oct. and Nov., 1902.)—The author has given special attention to preparing clear diagrams, which are shaded to show relief. By their aid he derives Encke's general formula as given in the Berliner Jahrbuch, 1830, p. 292, B. A. E.

108. *Airy's Theory of the Rainbow.* **D. Hammer.** (Frank. Inst., Journ. 156. pp. 335–349, Nov., 1903.)—A simplified explanation of the above diffraction theory from material taken from Pernter's writings on the same subject to show the superiority of this theory to that of Descartes. G. E. A.

109. *Variation of Atmospheric Absorption.* **S. P. Langley.** (Nature, 69. p. 5, Nov. 5, 1903.)—Observations made at Washington from autumn, 1901, to summer, 1903, and briefly tabulated in the paper, show that the absorption has steadily increased; this might be connected with the cool weather. H. B.

110. *Variation of Atmospheric Absorption.* **J. Talbot.** (Nature, 69. p. 30, Nov. 12, 1903.)—Photographing at an altitude of 11,000 feet in Switzerland, the author had in 1903 to expose for 3 secs., instead of 1 sec. in 1902. H. B.

111. *Determination of the Colours on Radde's International Scale of Colour.* **M. Topolansky.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 67–81, Jan.–March, 1903. From the II. Physik. Institut der k.k. Universität in Wien.)—This work was undertaken with a view of determining the various colours on Radde's international colour scale in terms of the three-colour system, and the results obtained are given in the paper. E. C. C. B.

112. *Optical Activity of Hæmoglobin and Globin.* **A. Gamgee** and **A. C. Hill.** (Roy. Soc., Proc. 71. pp. 376–385, April 7, 1903.)—Measurements of the optical rotations of solutions of hæmoglobin and its derivatives, made by means of a large Lippich half-shadow polarimeter, using light of wave-length $\lambda = 665{\cdot}3\ \mu\mu$, gave for hæmoglobin, oxyhæmoglobin, and carbon monoxide hæmoglobin the specific rotation $+10{\cdot}4^\circ$; these substances are the first known examples of dextro-rotatory proteid substances. The value for globin is $-54{\cdot}2^\circ$. T. H. P.

HEAT.

113. *Regulating and Recording Thermometer.* **H. S. Allen.** (Nature, 68. pp. 69–70, May 21, 1903.)—A description of an apparatus for regulating the temperature of a room with considerable accuracy or for keeping a continuous record of temperature. The essential part is a piece of flat brass tubing bent into a spiral form and filled with a liquid of large expansion-coefficient. A magnifying lever arrangement is attached. The instrument is intended for use within a range of a few degrees only. For regulation purposes the indicating pen on the lever is replaced by a platinum point which completes an electric circuit or works a relay so as to recommence the heating.

J. W. P.

114. *Influence of a Magnetic Field on Thermal Conductivity.* **V. J. Blyth.** (Phil. Mag. 5. pp. 529–537, May, 1903.)—A transverse field produces practically no effect with bismuth, but the conductivity of mild steel is reduced by 2·1 and 3·3 per cent. in transverse fields of 6,700 and 7,500, and by 4 per cent. in a longitudinal field of 51. A transverse field of 7,850 reduces the conductivity of soft iron by 1 per cent., while a longitudinal field producing a magnetic induction of 16,000 per sq. cm. reduces it by 10·5 per cent.

R. E. B.

115. *Standard Unit of Refrigeration.* **J. C. Bertsch.** (Amer. Soc. Mech. Engin., Trans. 25. No. 05. pp. 1–13, Dec., 1903.)—The author proposes the following conditions for calculating the actual work performed by a refrigerating machine of the ammonia-compression type. (1) 284,000 British thermal units, as the latent heat of 2,000 pounds of ice constitute one ton of refrigeration. (2) The efficiency of the ammonia compressor is 75 per cent. of the theoretical capacity. (3) The limit of piston travel per minute shall be: 180 feet for strokes up to and including 12 inches; 240 feet for strokes over 12 and including 24 inches; 300 feet for strokes over 24 and including 36 inches; 360 feet for strokes over 36. (4) The temperature to be produced 15° F., and the boiling point of the evaporating ammonia 0°. (5) The temperature of the condensing water is taken at 75° F., and that of the liquid ammonia at 80°. (6) The displacement of the compressor must be 5 cubic feet or 8,640 cubic inches per ton per minute. Calculating on these bases it is found that one practical ton of refrigeration equals 0·68 ton of actual ice-making capacity. A table is given in which the builders' ratings of various machines are compared with the actual capacities according to the above proposals for a standard unit. With most of the single-acting machines these two numbers agree very closely, but the capacities of most of those of the double-acting type show great divergencies.

T. H. P.

116. *Atomic Latent Heats of Fusion of the Metals.* **H. Crompton.** (Chem. News, 88. p. 237, Nov. 13, 1903. Paper read before the British Association (Section B) at Southport, 1903.)—A test of the validity of the formula $\frac{Ar}{T} = 2·96$ where A = atomic weight of metal, r = latent heat of fusion per gramme, T = absolute temperature of fusion. The above formula rests on the

following, amongst other, assumptions. (1) That in the case of a monatomic liquid, the increase of energy (supposed to be entirely kinetic energy of molecular translation) per degree Centigrade is the same as the increase in the case of a monatomic gas at constant volume, *i.e.*, 2·96 calories per gm. mol. (or per gm. atom). (2) That the total kinetic energy of a monatomic liquid at T (absolute) is therefore 2·96 T calories per gm. atom. (3) That *all* this energy appears as heat when the liquid freezes. On collecting the available data it is found that the value of Ar/T varies from 1·84 for K to 3·05 for Sn, the average of fourteen values being 2·4. Bismuth and gallium form exceptions, the values of the "constant" being 4·82 and 4·67 respectively. These and other minor differences may be due to the fact that the metals are not all monatomic in the liquid state. F. G. D.

117. *Temperature Coefficients of some Iodine Elements.* **O. Steindler.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1312–1318, Oct. and Nov., 1902. From the II. Physik. Institut der Wiener Universität.)—Results are given of measurements at various temperatures of the e.m.f.'s of the following elements: Ag | I | C; Zn | I | C; Mg | I | C; Cd | I | C; Al | I | C; Hg | I | C. The temperature coefficients measured are given below, together with those calculated from Helmholtz's equation:

	Temperature Coefficients.	
	Found.	Calculated.
Ag	+ 0·0004	+ 0·0011
Zn	— 0·0013	— 0·0011
Mg	— 0·005	— 0·0047
Cd	+ 0·0048	— 0·0002
Al	— 0·0017	— 0·00093
Hg	+ 0·0119	— 0·00086

Thus, in the case of the silver, zinc, magnesium and aluminium elements, Helmholtz's equation holds good both qualitatively and quantitatively. No explanation is given for the deviation in the case of the cadmium element, the separate readings obtained agreeing very well among themselves. The abnormality in the case of the mercury element is mainly due to the simultaneous formation, in unknown proportions, of both mercuric and mercurous iodide. T. H. P.

118. *Constants of Aniline and other Organic Compounds.* **de Forcrand.** (Comptes Rendus, 136. pp. 945–948, April 20, 1903.)—Experimental determinations are given of the values of the specific heats and heats of volatilisation or of fusion of aniline, nitrobenzene, benzene, and acetic acid, with the object of testing the correctness of the author's formula $(L+S)/T=30$ (about). For aniline the final corrected values are given as follows: Specific heat in liquid condition $C_l=0·4888$ about 0°; specific heat in solid condition $C_s=0·2230$ about $-15°$; heat of solidification or of fusion for 1 gm. $s=0·0399$ cal. at $-7°·03$; heat of solidification (molecular) $S=3·711$ cal. at $-7°·03$; for nitrobenzene $\dfrac{L+S}{T}=25·80$; for benzene the quotient is 27·57. These numbers appear anomalous. In the case of acetic acid there is no anomaly,

$C_s = 0·315$ and $C_l = 0·500$. The heat of solution of solid acetic acid at + 12° is found to be − 2·240, the constant for the same substance in the liquid condition being − 0·389 at + 13°·6, the value of S being 2·629 calories. J. J. S.

119. *Temperature of the Change of State in Crystals.* **R. V. Sahmen** and **G. Tammann.** (Ann. d. Physik, 10. 4. pp. 879–890, March, 1903.)—Place any crystalline substance, say potassium carbonate, in a silver tube open at both ends and put the whole in a porcelain tube. Let one rod press against the end of the silver tube and another rod against the crystalline cylinder. If the whole be raised in temperature, the silver expands at a known and almost uniform rate and the crystalline body follows a more complex law; the two rods actuate levers which trace curves on a dilatograph. Thus it is easy to ascertain the expansibility of the crystalline body. In this way it is found that sodium phosphate contracts at about 330° and expands rapidly at 530°; potassium carbonate shows greatest expansibility at 400°, and so for many substances, including quartz. P. E. S.

120. *Vapour Pressure of Liquid Oxygen.* **M. W. Travers** and **C. J. Fox.** (Roy. Soc., Proc. 72. pp. 386–391, Nov. 21, 1903.)—The apparatus and method are identical with those described previously [see Abstract No. 1025 (1903)], except that a constant volume oxygen scale is used, whereas before there was a constant volume hydrogen scale. It is found that the mean values of the difference of temperature corresponding to the same vapour-pressure of liquid oxygen on the oxygen and hydrogen scales, when plotted against initial pressures, lie on a straight line. The results are compared with Callendar's theory as to the deviation of these scales from the thermodynamic scale.
P. E. S.

121. *Form of the Practical Isothermal in Gaseous Mixtures.* **F. Caubet.** (Zeitschr. Phys. Chem. 43. pp. 115–117, March 13, 1903.)—Kuenen [see Abstract No. 184 (1903)] called attention to the impossibility of the isothermals given by the author for methylchloride and sulphur dioxide [see Abstract No. 1932 (1902)]. On referring to his original paper the author finds an error in the drawing of the curves; in reality, the observed numbers proceed quite according to theory. T. H. P.

122. *Relation between Stefan's Formulæ for the Internal Pressure of Liquids and van der Waals' Equation.* **A. Brandt.** (Ann. d. Physik, 10. 4. pp. 783–788, March, 1903.)—Stefan (Wied. Ann., 1886, 29. 555) has given the following formulæ for the internal pressure of liquids: $B = (P_2 - p_0)v_2$ and $2B = C \log (P_2/P_1) + P_2 v_2 - P_1 v_1$; B being the mechanical equivalent of the heat required to transfer a unit weight from the interior of a liquid to the surface and then vaporise it, P_2 the sum of the cohesion pressure and the external pressure p_0 for a point within the liquid, v_2 the specific volume of the liquid, and P_1 and v_1 the corresponding values for a point in the vapour above the liquid. The author shows that these expressions can be easily deduced from van der Waals' equation, and hence merit attention in the consideration of the connection between the theories of vaporisation and capillarity. T. H. P.

123. *Two Ways of Proving Maxwell's Law of Distribution of the Velocities of Gas Molecules.* **G. Jäger.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a.

pp. 309–318, April–June, 1903.)—The important question as regards any proof of Maxwell's law is on what assumption it is based, because it has long been known that it can be proved on suitable assumptions. In his first proof the writer assumes a great number of molecules to be in motion in a vertical cylinder divided into two halves by a horizontal plane AB, but instead of the continuous force of gravity acting on them he assumes for mathematical purposes that a molecule passing that plane from above gains kinetic energy *a*, a molecule passing that plane from below loses kinetic energy *a*, if it has so much to lose, or if not, has to stay below. Nothing is stated concerning the dimensions of the molecules, so they are impliedly assumed to be material points having finite mass but infinitely small dimensions. Nothing is said concerning any forces acting except the discontinuous force on AB, afterwards converted by usual mathematical methods into a continuous force. It is therefore impliedly assumed that no intermolecular forces act. It is also impliedly assumed, as nothing is said to the contrary, that the chance of a molecule having velocities within assigned limits is independent of the positions and velocities of the other molecules, which is a consequence of, is in fact asserted by, Maxwell's law. On these assumptions it is proved that when the number crossing the plane upwards is the same as the number crossing it downwards—*i.e.*, when the system is in equilibrium—the distribution must be according to the Maxwell-Boltzmann law $e^{-h\left(m\frac{u^2}{2}+2\chi\right)}$, χ denoting the potential of the now continuous force. In the second proof he assumes further that Boyle's law is accurately satisfied, and deduces the same result from the hydrodynamical equation $\rho S - \frac{dp}{dS} = 0$, where ρ denotes density, p pressure, and S the resultant force. [See also Abstract No. 444 (1903).] S. H. B.

REFERENCES.

124. *Air-Cooling Apparatus.* (Scientific American, 88. p. 372, May 16, 1903.)—A description of an arrangement made by W. L. Moore, which by draught tubes and melted ice, cools a room: a sort of "negative stove." J. W. P.

125. *Radiation Laws.* **P. Gruner.** (Phys. Zeitschr. 4. pp. 305–306, March 1, 1903.)—The experiments of Wagner (Zürich Inaugural Dissertation, 1899) are better in accord with Stefan's law than with Weber's. A. D.

126. *Radiation Formulæ and the Principles of Thermometry.* **E. Buckingham.** (Monthly Weather Rev. 31. pp. 178–180, April, 1903.)—The author disagrees with certain remarks of Bigelow [see Abstract No. 875 (1903)], chiefly in connection with the extrapolation of temperature to very high values. E. C. C. B.

127. *Foundations of Thermodynamics.* **A. Einstein.** (Ann. d. Physik, 11. 1. pp. 170–187, April, 1903.)—This is an attempt to deduce the theorems regarding equilibrium of temperature and entropy from general considerations of the relations between different systems in a condition of stationary motion and in contact with each other. It is too mathematical to abstract. [See also Abstract No. 452 (1903).] R. E. B.

ELECTRICITY AND MAGNETISM.

THEORY AND ELECTROSTATICS.

128. *Approximately Satisfied Currents in the Space Bounded by Two Concentric Spheres.* **E. Riecke.** (Gesell. Wiss. Göttingen, Nachr. Math.-Phys. Klasse, 4. pp. 149–154, 1903.)—In this paper the author continues the discussion of the problem dealt with in his former paper [see Abstract No. 1218 (1903)]. He here considers the terminal conditions by which have to be determined the constants of integration. One is that on the surface of the inner sphere the electric force must be e/r^2, where e is the charge, r the radius of that sphere. For another condition he had in the former paper assumed that on the surface of the inner sphere the density of positive ions is zero. This he rejects as unsatisfactory. He now substitutes the condition that the whole loss of electricity on the inner sphere is accounted for by the negative ions. Further changes are made in the formulæ of the former paper. But as regards numerical results these corrections do not materially modify those formulæ. S. H. B.

129. *Approximately Satisfied Currents between Parallel Plates.* **E. Riecke.** (Gesell. Wiss. Göttingen, Nachr. Math.-Phys. Klasse, 4. pp. 336–348, 1903.)—The same notation is employed in this as in the previous papers by the same author [see Abstracts No. 1218 and 1421 (1903)]. The problem here considered is that of two parallel planes distant l from each other, of which one, taken as the plane of yz, has a positive charge, while the other is connected to earth. F denotes the electric force in direction x, q the rate of ionisation, $\overset{+}{\mathrm{N}}$ and $\overset{-}{\mathrm{N}}$ the number per unit of volume of positive and negative ions respectively. Also ϵ is the density of positive electricity in space, ν the velocity of light, U and V the mobilities of positive and negative ions, $\overset{+}{k}$ and $\overset{-}{k}$ their diffusion coefficients, a the coefficient of recombination. He gives four fundamental equations, $d\mathrm{F}/dx = 4\pi\epsilon(\overset{+}{\mathrm{N}} - \overset{-}{\mathrm{N}})$,
$\nu\epsilon(\mathrm{U}\overset{+}{\mathrm{N}} + \mathrm{V}\overset{-}{\mathrm{N}})\mathrm{F} - \epsilon d/dx(\overset{+}{k}\overset{+}{\mathrm{N}} - \overset{-}{k}\overset{-}{\mathrm{N}}) = c$ the electric current supposed known,
$q = \nu\mathrm{U}d(\overset{+}{\mathrm{N}}\mathrm{F})/dx - \overset{+}{k}d^2\overset{+}{\mathrm{N}}/dx^2 + a\overset{+}{\mathrm{N}}\overset{-}{\mathrm{N}}, \quad = -\nu\mathrm{V}d(\overset{-}{\mathrm{N}}\mathrm{F})/dx - \overset{-}{k}d^2\overset{-}{\mathrm{N}}/dx^2 + a\overset{+}{\mathrm{N}}\overset{-}{\mathrm{N}}$.
From these equations he deduces formulæ for the satisfied current with numerical results; also two different methods of approximation for the non-satisfied current. [See also preceding Abstract.] S. H. B.

130. *Application of Fredholm's Functional Equation in the Theory of Potential.* **J. Plemelj.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 21–29, Jan.–March, 1903.)—If $\mathrm{W}(p)$ denote the potential of a double surface or condenser, we have an equation of the form: $\mathrm{W}(p) = \int\kappa(t)\dfrac{\cos(r_t\, r_{tp})}{2\pi r_{tp}^2 dt}$, which may be written $\int\kappa(t)h(tp)dt$, and on the surface of discontinuity s'—

$$\mathrm{W}(s^i) - \mathrm{W}(s^a) = 2\kappa(s) \qquad \mathrm{W}(s^i) + \mathrm{W}(s^a) = 2\int\kappa(t)h(ts)dt.$$

Fredholm's functional equation is: $\kappa(s) = \phi(s) + \lambda\int\kappa(\theta)h(\theta s)$. The writer in this paper gives his conclusions only, eleven in number, without proof. He considers that the "conductor problem," *i.e.*, the problem of finding the constant potential of a conductor, is made capable of easy solution by the method developed in this paper. S. H. B.

131. *Electromagnetic Vibrations of a Sphere Surrounded by a Concentric Spherical Dielectric.* **A. Lampa.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 37–66, Jan.–March, 1903.)—The conclusions arrived at in this mathematical paper, for an exciter of electromagnetic vibrations, which is embedded in a limited dielectric whose constant is greater than that of air, are: (1) the period of the vibrations is increased; (2) their damping is diminished; (3) the wave-length of the electromagnetic radiation in the air surrounding the dielectric is increased. The first and last of those conclusions are confirmed by the work of Kossonogoff on optical resonance. [See Abstract No. 1348 (1903).] W. S.

132. *Absorption of Electric Waves in a Gas.* **F. Hasenöhrl.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1229–1263, Oct. and Nov., 1902, and 112. 2a. pp. 30–35, Jan.–March, 1903.)—After explaining the difficulties encountered by Lamb, J. J. Thomson, Kolaček and others, in the investigation of this subject, the writer announces his intention of avoiding them by investigating, not the emission, but the absorption of electric waves by a sphere of conducting dielectric, but the ohmic currents are regarded as negligible in comparison with the so-called displacement currents. On such a sphere falls a plane and plane polarised, electric wave, and part of its energy is reflected, part absorbed, and again radiated. A gas is supposed to consist of a great number of such spheres uniformly distributed, and the ever-recurring assumption is made that their mean distance from each other is very great compared with their diameters. We may expect to find, he says, something resembling an absorption spectrum. The course of the subsequent investigation, as the mathematics cannot be abstracted, is best given in the author's words as near as may be. In section (1) he transforms Lamb's rectangular into polar coordinates for a single sphere. In section (2) he calculates the electromagnetic effects which follow the incidence of the wave on the sphere. In section (3) the components of the electric force outside of the sphere are calculated in rectangular co-ordinates. In section (4), instead of a single sphere, he introduces the system of spheres constituting the gas, bounded by an infinite plane perpendicular to the wave, and the spheres are assumed to be at rest, at least relatively to the velocity of light. Section (5) continues the calculations thereout arising. In section (6) he gives the result of these calculations. A wave is radiated by the spheres (molecules), which at a distance great compared with that between two spheres (molecules), may be regarded as a plane wave whose direction is at right angles to the bounding plane of the gas. Finally, in section (7), he calculates the absorption index of the medium above defined. He remarks that if the incident wave be not homogeneous, but consists of waves of all different lengths, we should have a line absorption spectrum. In the second part the author shows the relations between the theory which he has given and the theory of anomalous dispersion given by Rayleigh [see Abstract No. 1344 (1899)] and Kolaček (Wied. Ann. 32. p. 224 A.A.O.). S. H. B.

133. *Undistorted Cylindrical Wave.* **O. Heaviside.** (Nature, 68. pp. 54–55, May 21, 1903.)—Undistorted cylindrical electromagnetic waves cannot be produced by impulses from a simple axial source, for the whole space up to the wave front is filled with disturbance. They can, however, be produced by a condenser consisting of an infinite plane conducting sheet, having a straight-edge, and a straight wire parallel to and close to that edge. The source in this case is not a simple line source, but really consists of a doublet. Take plane co-ordinates r and θ. Let the magnetic force be perpendicular to the plane, of intensity H. Let Z be its time-integral. Then the magnetic field is given by—

$$(1)\ Z=\cos\tfrac{1}{2}\theta/vr^{\frac{1}{2}}.f(vt-r),\qquad H=\cos\tfrac{1}{2}\theta/r^{\frac{1}{2}}.f'(vt-r),$$

f being an arbitrary function. If E_1 and E_2 are the radial and the tangential components of the electric force, the electric field is given by—

$$(2)\ E_1=-\mu v\sin\tfrac{1}{2}\theta/2r^{\frac{3}{2}}f,\qquad E_2=\mu v\cos\tfrac{1}{2}\theta/r^{\frac{1}{2}}.f'+\mu v\cos\tfrac{1}{2}\theta/2r^{\frac{3}{2}}.f.$$

The attenuation factor $r^{-\frac{1}{2}}$ does not count as distortion. Taking, as example, the case cited above in its ideal form in which the wire becomes a mere line brought close up to the straight-edge; then if a battery is connected to the plate and wire and then disconnected, the field is given by—

$$(3)\ cvE_1=-\sin\tfrac{1}{2}\theta/2r^{\frac{3}{2}}.f_0,\ cv_2E_2=\cos\tfrac{1}{2}\theta/2r^{\frac{3}{2}}.f_0.\ f_0=\text{constant},\ c=\text{permittivity}.$$

When discharge is effected by contact between the edge and wire, a wave starts out with velocity v, and swallows up the whole energy of the field as it passes, carrying it off to infinity; thus at time t after contact there is a cylindrical wave of radius vt separating space outside with the above field (3) from space inside devoid of both electric and magnetic forces. Similarly on charging, a wave sets out and lays down the electric and magnetic fields on its way. J. D. C.

134. *Distribution of Electricity in the Atmosphere.* **Y. Homma.** (Mathematical and Physical Soc., Tokyo, 1. 8. pp. 45–50, 1901–1903.)—The author assumes the earth to be a sphere having a negative charge uniformly distributed over its surface, and the complementary positive charge to be uniformly distributed over concentric spherical shells in the atmosphere, so that taking earth and atmosphere together as one celestial body, it is neutral. That being the case, V, the electric potential satisfies—

$$\frac{d^2V}{dr^2}+\frac{2}{r}\frac{dV}{dr}+4\pi\rho=0$$

if ρ be the density at any point in the atmosphere. Consistently with these conditions, ρ may vary as a function of r in a variety of ways, and the writer works out the integration for different hypotheses with regard to ρ. From the experiments of Lecher, Tuma and Le Cadet he concludes that at great elevations the density tends to diminish with increasing height. S. H. B.

135. *Special Cases of Lines of Force Due to a Homogeneous Body of Revolution.* **H. Nagaoka.** (Mathematical and Physical Soc., Tokyo, 1. 9. pp. 59–61, 1901–1903.)—Taking the axis of rotation for that of z, and U to denote the Newtonian potential, the writer considers a fictitious distribution whose potential is $V=-dU/dz$, whence he gives, r being the distance from the axis, $dV/dr=1/r.d/dz(r.dU/dr)$, $dV/dz=-1/r.d/dr(r.dU/dr)$, and for the equation of the lines of force $\psi=-r.dU/dr=$ constant. Two special cases are considered and worked out in detail by means of Bessel's functions, first lines of force due to an ellipsoid of rotation uniformly magnetised, and secondly lines of force due to a circular magnetic shell. S. H. B.

136. *A New Foundation for Electrodynamics.* **A. W. Conway.** (Roy. Dublin Soc., Trans. 8. 3. pp. 53–56, Nov., 1903.)—The new foundation is in effect Levi-Civita's theory of the retarded potential. Helmholtz's expression for the electric force (X Y Z) is first given, agreeing with Maxwell's, in the form $-V^2(\partial/\partial x, \partial/\partial y, \partial/\partial z)\psi$, $-V^2\partial/\partial t(F, G, H)$. V being the velocity of light, ψ the potential of electric charges, and F, G, H the components of vector potential. Levi-Civita is then introduced. If an electron at A moves to B in time ∂t, the disturbance from A reaches a point P on a sphere of radius r described about A in time r/V, and the disturbance from B reaches a sphere of radius $(t - \partial t)/t \cdot r$ described about B in time $t - \partial t$. Hence if v be the velocity of the electron, θ the angle which its direction makes with OP, we have $BP : AP :: V - v\cos\theta : V$.

If then Ae/r be the potential of a charge e under the law of instantaneous action, the potential in the Levi-Civita system should be $AeV/r(V - v\cos\theta)$. This the writer gives, but he bases his conclusion on the not very clear statement that the thickness of the shell between the two spheres, varies as $V/(V - v\cos\theta)$. S. H. B.

137. *Magnetic Effect of Moving Dielectric.* **A. Eichenwald.** (Phys. Zeitschr. 4. pp. 308–310, March 1, 1903.)—When a condenser is charged to a given potential difference, and is moved (rotated) together with its dielectric, a magnetic effect is produced, which is independent of the material of the dielectric. When it is rotated (while not otherwise charged) in an electrostatic field the effects are the same. The effect is proportional to the movement of the charge relative to its own electric field; and it is concluded that the ether is not displaceable. A. D.

138. *Kelvin's Thermo-electric Theory.* **O. Heaviside.** (Nature, 68. pp. 78–79, May 28, 1903.)—When the theory is extended, considering the current as the curl of the magnetic force of the field, and taking metal-air junctions into account, it is found that Kelvin's $\Sigma p d\theta$ in the metal circuit alone is a fictitious distribution, which not only gives the same steady current as the real distribution of intrinsic force, but also gives the true E and H everywhere in variable states as well, provided the real intrinsic forces include the metal-air forces along with the Peltier and Thomson forces. A. D.

139. *Charging through Ion Absorption.* **G. C. Simpson.** (Phil. Mag. 6. pp. 589–598, Nov., 1903.)—Referring to Elster and Geitel's theory that the permanent negative charge on the earth's surface is due to a charging of the surface through absorption of ions from the surrounding atmosphere [see Abstract No. 1281 (1900)], and to experiments made by Zeleny and Villari [see Abstracts Nos. 251 (1899) and 40 (1902)], the author carried out various experiments, and obtained a charge as the result of ion absorption, but it was in every case accompanied by the removal of air from the action of a strong ioniser to a place where diffusion could come into play. In the atmosphere such removal does not take place. It appears to be the result both of theory and experiment, that in air at rest there is no tendency for an insulated conductor to become charged negatively as a result of the difference in the mobility of the ions. Moreover, the theory cannot be accepted that in all places protected against the formation of an electric field, such as within a conductor, there is a continual stream of negative ions out of the air, for the positive ions which this would leave behind are all within molecular distances of the surface, and so hold an equal quantity of electricity as a "bound

charge," no electricity being able therefore to appear as a free charge. A conductor has not yet been charged as a result of its motion relative to the naturally ionised air of the laboratory. The experiments made do not support the existence of the process which Elster and Geitel considered as taking place in the atmosphere, and indicate that the problem of the earth's negative charges cannot be regarded as solved by supposing absorption of ions from the atmosphere. J. J. S.

DISCHARGE AND OSCILLATIONS.

140. *Electric Conductivity of Air.* **J. C. McLennan and E. F. Burton.** (Univ. of Toronto, Phys. Sci. Series, pp. 17–24, 1903. Paper read before Amer. Phys. Soc. at Washington, Dec. 31, 1902.)—Air is (Elster and Geitel, C. T. R. Wilson and others) continually ionised by some agent and capable of exciting radio-activity: and the authors find it to behave as if (1) it is always ionised by emanations which rapidly decay, (2) it is more slowly ionised by emanations from the metal of a containing vessel, (3) equilibrium is ultimately reached between the decay and the production of these emanations from the metal, which in their turn vary with the particular metal used, being most active from the metals of highest atomic weight, and (4) the ordinary external air is traversed by exceedingly penetrating emanations which come through the walls of the metal containing vessel. The increase in conductivity is almost directly proportional to the pressure at which the air is kept. A. D.

141. *Electrical Conduction.* **R. J. Strutt.** (Roy. Inst., Proc. pp. 1–7, April 24, 1903.)—A lecture on some recent investigations on Electrical Conduction, in which evidence is brought forward to show that the leakage of electricity from a charged body, though slight, and always found in the case of air, is not an essential property of the air itself, but is due to feeble radio-activity in the surrounding solid objects. It is probable that a metallic vapour like that of mercury behaves differently, and it seems as if at the critical temperature, if experiments could be carried out, it would be found that the saturated vapour approached in its electrical behaviour to the liquid metal. J. J. S.

142. *Ionisation produced by Radium Corpuscles.* **J. J. E. Durack.** (Phil. Mag. 5. pp. 550–561, May, 1903.)—In a former paper Durack has shown that the corpuscles in the Lenard ray stream make on the average 0·4 positive and negative ions in travelling through 1 cm. of air at a pressure of 1 mm. of mercury, or under those conditions the number of collisions made by the corpuscles is 0·4 [see Abstract No. 94 (1903)]. This number measures the specific ionisation in air, and is denoted by the symbol a in the paper. The number obtained by Townsend for this constant is higher than that obtained by the author, and the difference is supposed to be due to the different velocities of the corpuscles in the different experiments. It is probable that a for the deflectible Becquerel rays is less than that for the Lenard rays. Townsend estimated the value of a for radium corpuscles to be 18. This number the author considers from the experiments described to be 76 times too large. The leak produced by the corpuscles from radium was measured, and the results of three series of observations are given. N_0 being the number of corpuscles passing through a thin aluminium plate (0·088 mm. thick), and ϵ

the charge carried by a corpuscle, the current due to the corpuscles is $-N_0 e$. The numbers obtained for $N_0 e$ are 4·8, 8·7, and 3·7. The change from 4·8 to 8·7 in the Becquerel ray current was produced by practically doubling the distance travelled by the corpuscles before they reach the place where ionisation takes place. The corresponding numbers for α from the three sets of observations made with the current values given above are respectively $\alpha = 0·168$, 0·175, and 0·168. From these values of α the mean free path of the Becquerel ray corpuscles in air at 1 mm. is about 6 cm. This very large value for the mean free path accounts for the very small absorption of the deflectible Becquerel rays. J. J. S.

143. *Ionisation in Atmospheric Air.* **J. A. McClelland.** (Roy. Soc. Dublin, Trans. 8. 4. pp. 57–64, Nov., 1903.)—The experiments described in this paper have to do with the slight ionisation existing in atmospheric air in its normal condition. The leak of electricity between two plates, one charged positively, and the other first of all connected to earth and then insulated, was observed. The second plate steadily rises in potential. No leakage across the supports of the plate was possible, as these rested on earth-connected conductors. The current must have been through the air, and the conductivity is of the nature resulting from ionisation of a gas. A number of observations were made under various conditions and at different times. Considerable changes in the amount of ionisation of the air were found to occur, the greatest ionisation being observed after several hours' steady rain. The smallest ionisation occurred after a slight shower. This is probably due to the removal of ions from the air by condensation on them of water-vapour. The facts, on the whole, point to the presence of some radio-active substance disseminated through the atmosphere. J. J. S.

144. *Genesis of Ions by Motion of Positive Ions.* **J. S. Townsend.** (Phil. Mag. 6. pp. 598–618, Nov., 1903.)—When ultra-violet light falls on the negative plate of two parallel oppositely-charged electrodes, the gas between conducts, and the conductivity is measured by a special arrangement which includes a condenser, an induction balance and a quadrant electrometer. Excellent agreement is found between theory and experimental results. Air and hydrogen were each tested for pressures of about 1–8 mm. of mercury. The paper also gives a theory of the sparking potential between parallel plates in partial vacua, as related to the distance between the plates. [See also Abstract No. 1511 (1903).] P. E. S.

145. *Discharge of Electricity from Hot Platinum.* **H. A. Wilson.** (Roy. Soc., Phil. Trans. 202. pp. 243–275, Nov. 14, 1903.)—An account is given of the results obtained in a series of experiments on the loss of electricity from hot platinum in several gases at various pressures. The variation of the leak with the temperature of the wire, the pressure of the gas, and the nature of the gas, was investigated. Some results are also given on the leak from a hot palladium wire. The following are the principal conclusions reached: (1) The negative leak from a hot platinum wire in air nitrogen or water vapour is independent of the gas pressure, unless ionisation by collisions occurs, and is the same as the negative leak from the same wire in a good vacuum. (2) The variation of the negative leak in air with the p.d. and pressure at constant temperature can be explained on the hypothesis that the negative ions produce ionisation by collisions with the air molecules. (3) The number of

collisions made by a negative ion probably varies inversely as the absolute temperature at constant pressure. (4) The variation of the negative leak per sq. cm. with the temperature can be expressed by the equation $x = A\theta^{\frac{1}{2}}\epsilon^{-Q/2\theta}$, where x is the current in amperes, θ the absolute temp., and Q and A are constants. (5) The negative leak in hydrogen is much larger than in air or in a vacuum. At low pressures it is nearly proportional to the pressure of the hydrogen. (6) The presence of the hydrogen changes the value of the constants Q and A. At low pressures (less than 0·0015) the value found for Q was about 130,000, A being about 1×10^7 or a little less. At pressures of 0·112 and 133·0 respectively the values of Q were 85,900 and 86,000, and of A $5{\cdot}3 \times 10^4$ and 0·1. (7) It is very probable that the negative leak in air or in a vacuum is due to traces of hydrogen or other substances in the wire. The leak can be reduced to $\frac{1}{250000}$th part of its ordinary value by the removal of such traces. (8) On first heating a positively charged palladium wire in a vacuum, it can discharge positive electricity. The rate of discharge falls off rapidly with time and ultimately becomes inappreciable. (9) In air and hydrogen, at pressures above several mm., there is a permanent positive leak from hot platinum which increases with the pressure. This leak is larger in hydrogen than in air at the same temperature. O. W. Richardson has proposed the theory that the negative leak is due to the escape of the corpuscles which, on the ionic theory of metallic conduction, metals contain. According to his view the leak depends only on the state of the platinum and not on the surrounding gas. The experiments described in the present paper indicate that the negative leak from hot platinum is due to the emission of negatively charged corpuscles or electrons, but the number of these emitted depends on the gases and other substances present at the surface of the platinum. The temporary positive leak from platinum and palladium when first heated may be due to the presence of some volatile impurity. The positive leak in gases at high pressures appears to be due to ionisation of the gas molecules at the surface of the platinum. J. J. S.

146. *Thermic Conductivity of Electric Arc Electrodes.* **G. Granqvist.** (Paper read before the Upsala Royal Scientific Society, pp. 1–56, 1903.)—Carbon arcs show in many respects great differences from arcs between metallic electrodes, these differences being specially striking when the arc is fed by alternating currents. Whereas, for instance, no difficulty is encountered in producing carbon arcs by means of alternating currrents if both electrodes are of carbon, or metal arcs in the case of one electrode being of carbon and the other of metal, it has so far been impossible to maintain an arc between two metallic electrodes by means of alternating current of ordinary voltage and frequency. As this seems to be due to the great difference in thermic conductivity of carbon and metal electrodes, the author has investigated the *rôle* incumbent on the thermic conductivity of electrodes with both continuous current and alternating current arcs. The principal results are as follows: In alternating current arcs the state of equilibrium is alternately stable and unstable; in the latter case both the electrodes and the arc itself are found to be cooled, and if this cooling exceeds a certain limit, the arc ceases. The smaller the energy supplied in the stable state, and the greater the thermic conductivity of the electrodes, the higher will be the rate of cooling of the arc, and the shorter the unstable period, provided the arc does not cease. The thermic conductivity of the electrode is thus found to play a much greater part with alternating than with continuous current arcs. A. G.

147. *Murphy High-Potential Interrupter.* **A. F. Collins.** (Elect. World and Engineer, 42. pp. 889–890, Nov. 28, 1903.)—In this article is described a new method of producing rapid successive interruptions and restorations of high-potential currents, devised by T. J. Murphy. The method consists in providing in the high-potential circuit, which may be fed by a dynamo, an air-gap preferably between carbon electrodes which are maintained a proper distance apart by means of an arc lamp mechanism or similar device, the whole arrangement being enclosed in a partial vacuum for the purpose of securing uniformity in action. The gap is usually so long that the potential cannot disrupt the air by itself, and an auxiliary circuit fed by an induction coil or transformer is so connected as to be able to discharge across this main gap, an additional small gap being included in the auxiliary circuit, and also sometimes choking coils, so that no closed circuit leads the main current through the auxiliary circuit. When the coil is caused to discharge across the gaps, the conductivity of the air in the main gap is so much increased that the comparatively low potential current from the main circuit can flow across between the carbons, a magnetic blow-out being provided which stops the arc as soon as the auxiliary spark ceases. In this way the number of discharges of the main circuit can be adjusted, by regulating the rate of sparking in the auxiliary circuit. The reactance of the main circuit is made so great that the potential in the auxiliary circuit always equalises by the arc electrodes. With a transformer in the auxiliary circuit the discharge is produced after the method of Fleming. It is found that until the critical e.m.f. and intensity of the auxiliary discharge is reached, the main current does not follow the spark unless both are positive or negative, the main current preferring to flow in the same direction as the auxiliary discharge. The interrupter has been operated on a direct current at 500 volts giving forth a musical sound very painful to the ear. The author suggests the applicability of the method to the rectification of alternating currents. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

148. *Electrical Separation at Contact-Surfaces.* **J. Billitzer.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 95–188, Jan.–March, 1903.)—Experiments on the deviation of metal wires suspended in a liquid under the action of a potential-gradient, on the travelling of colloid metals in an electric current and on the direction of the currents produced by the fall of finely divided metals in different solutions, lead to the conclusion that definite progressive additions to the liquid make the differences of potential between the metal and the liquid pass through a zero value and change their sign: that the zero values enable us to place the metals and liquids in a scale of absolute potential; that the metals Au, Pt, Pd, &c., do not differ by more than 0·02 volt from one another; and that Helmholtz's theory of double layers needs essential modification, there being dissociation and wandering of ions from these layers until the dissociation-pressure of these layers comes into equilibrium with the solution-pressure of the metal. A. D.

149. *Dielectric Constants of Mixtures of Hexane and Acetone.* **F. Ehrenhaft.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1549–1558, Oct. and Nov., 1902. From the II. Physik. Institut der Wiener Universität.)—The dielectric constants of mixtures of hexane and acetone do not follow the law of linear mixtures, but, when plotted against the percentage content by

volume, yield a curve closely resembling the density curve; so that the density-dielectric constant curve is very nearly a straight line. With mixtures of ether and benzene, which occupy a less volume than the separate constituents, the values of $\frac{k}{\sigma}$ are greater than those calculated from the formula—$k=\sigma(k_1\varepsilon+k_2)/(\sigma_1\varepsilon+\sigma_2)$, where k, k_1 and k_2 are the dielectric constants of the mixture and its two components, σ, σ_1 and σ_2 their densities, and ε the ratio of the volumes of the two constituents before mixing. T. H. P.

150. *Electrical Conductivity of Solutions in Amylamine.* **L. Kahlenberg** and **O. E. Ruhoff.** (Journ. Phys. Chem. 7. pp. 254–258, April, 1903.)—Silver nitrate, cadmium iodide, and ferric chloride give conducting solutions in amylamine, but the conductivity is in all cases small, and copper oleate dissolves without causing any increase in the conductivity of the solvent. The molecular conductivity of silver nitrate reaches a maximum at a dilution of $v=1{\cdot}158$, and decreases to a very small value at $v=82$ litres per gram-molecule. Cadmium iodide gives a maximum of molecular conductivity at $v=1{\cdot}095$, the molecular conductivity falling almost to zero at $v=5{\cdot}5$. In the case of ferric chloride, the limited solubility does not permit a maximum of molecular conductivity to be realised, but the observed values show a steady decrease as the dilution increases. These results are quite different to those observed in aqueous solutions. T. M. L.

151. *Voltaic Potential-difference between Metals.* **J. Brown.** (Phil. Mag. 5. pp. 591–594, May, 1903.)—Upon immersion in cold oil the surface-films continued to act so that the potential difference remained (falling slightly, probably on account of a slight conductivity in the oil); when the oil was heated above the boiling point of water, the films evaporated, and then, there being nothing to act electrolytically on the plates, there was no potential-difference. After removal of the oil (unless a protective varnish-like film had been formed) the moisture of the air again found access to the surface, and a difference of potential was again observed. A. D.

152. *Method of Rendering Selenium Conducting.* **A. Knothe.** (Elekt. Runds. 21. pp. 23–24, Nov. 1, 1903. From the Central-Zeitung für Optik und Mechanik.)—Two copper wires were wound round a plaster of Paris cylinder, the wires being laid along two screw-threads, and thereby being kept apart. The ends of the wires were fixed by embedding them in the plaster. A paste of sublimed selenium, prepared in one experiment by using water, and in another, alcohol, was next spread over the cylinder so as to fill up the space between the wires. The "cell" so prepared was next subjected to the action of sulphurous anhydride; for this purpose, a few fragments of sulphur were burnt on a perforated piece of sheet-metal, over which was placed a metal cylinder; in the issuing fumes the cell was held for at least a few minutes. The reducing action of the sulphurous acid converted the selenium into the red or conducting variety. The cell was then dried and, on being connected across the terminals of a Daniell's cell, was found to conduct as well as if the wires had been connected together. By enclosing the cell in a light-tight box, the author found that the conducting power did not depend on the presence of light, but was permanent. The author's experiments have led him to the following views: Selenium is to be regarded as a metal capable of readily undergoing oxidation, the oxidation products being, however, capable of easy reduction. Grey crystalline selenium is neutral, *i.e.*, it can with equal ease be

transformed into either a conductor or a non-conductor. Light and heat are reducing agents, and affect crystalline selenium much in the same way as they do silver: but in the case of selenium the change brought about by light is unstable, and a return to the original state takes place as soon as the exciting cause is removed. Heat may act as an oxidising as well as a reducing agent, converting the red selenium into the grey variety. A. H.

153. *Measurement of Small Capacity and Inductance.* **J. A. Fleming** and **W. C. Clinton.** (Phil. Mag. 5. pp. 493–511, May, 1903. Communicated by the Physical Society.)—These measurements have recently assumed great importance on account of wireless telegraphy. The method of rapid charge and discharge through a galvanometer is employed. Tuning-fork make-and-break devices being found troublesome, the authors adopt a special rotating commutator of three interlocking wheels—each having a brush. The brushes are respectively connected to one terminal of a galvanometer, one terminal of a condenser, and one terminal of a battery. The other terminals are joined together. 100 commutations per sec. can be obtained. A steady deflection (δ) of the galvanometer is obtained, and the steady current required to give δ is found, hence it is easy to determine the capacity. A special differential movable coil galvanometer is described, and this also is used in some determinations. Measurements are taken of the capacity of strips and of wires hung up under various conditions in a room, and the theoretical and experimental values are compared. It is found that the experimental value is generally about 10 per cent. higher than the calculated value; this result is attributed to the action of surrounding bodies, including that of the lead of the wire or strip itself. These measurements, as well as those of ordinary leyden-jars, are conveniently stated in micro-microfarads. Some convenient expressions for capacity are given. Thus a telegraph-wire l cm. long, d cm. diam., and h cm. above ground has, in micro-microfarads, a capacity $C = \dfrac{l}{4{\cdot}1454 \log_{10} \dfrac{2l}{d}}$

By using a double contact-breaker made on similar lines an instrument is obtained which acts like the secohmmeter of Ayrton and Perry, but is claimed to be superior to that apparatus. P. E. S.

154. *An Electrolytic Galvanometer.* **R. Heilbrun.** (Zeitschr. Elektrochem. 9. pp. 111–114, Feb. 5, 1903.)—The author describes for pedagogic purposes a convenient galvanometric arrangement of an electrolyte so as to show the presence, direction, &c., of a current flowing through the electrolyte, by its action on a magnetic needle placed as in ordinary galvanometers. The electrolyte is contained in a tube of rubber or other material coiled round the needle. D. H. J.

155. *Voltameters.* **A. Bartorelli.** (Phys. Zeitschr. 4. pp. 350–352, March 15, 1903.)—The author finds that with increase of the current the polarisation rises less rapidly than the law of proportionality would indicate: the curve being at first bent towards the axis of current-strength and then straight. For concentrations of 1, 5, 10, and 15 per cent. sulphuric acid with platinum electrodes, the maximum polarisation is reached at current densities of 50, 62, 75, and 100 milliamperes per sq. cm. at the electrodes. The maximum polarisation is 2·70 to 2·90 volts with concentrations from 1 to 15 per cent. A. D.

156. *Electrometer Capacity.* **F. Harms.** (Ann. d. Physik, 10. 4. pp. 816–829, March, 1903.)—The true capacity of an electrometer is independent of the charge on the needle and of its sensitiveness, whereas the apparent capacity depends on these. By the apparent capacity the author means the ratio of charge to potential when all other conductors near are *not* earthed. For the real capacity they are earthed. By trial it is found that the sensitiveness decreases as the initial charge on the needle increases; in some cases the potential and in others the sensitiveness of the needle is kept constant. Both the quadrant electrometer and also the gold-leaf electrometer are tested in these respects. P. E. S.

157. *Notes on the Coherer.* **A. H. Taylor.** (Phys. Rev. 16. pp. 199–228, April, 1903.)—The author gives the results of several years' work with the coherer and of practical experience in wireless telegraphy, and tries to reconcile his results with the work of Guthe and Trowbridge. [See Abstract No. 2209 (1900).] He makes use of three single steel-point coherers of which one has already been described. The others are here described and one of them illustrated, showing how the adjustment of the point can be regulated so closely that a movement of $\frac{1}{68000}$th inch can be effected. The arrangements and measuring instruments are described at length, and a number of tables and curves embodying the results are included. The author concludes that coherer phenomena may be divided into three classes corresponding to three stages in the condition of the contacts. First there is a feeble leakage-current due to vapour conductivity; second, the potential rises high enough to cause conduction by metallic ions. During considerable intervals of current the potential remains nearly constant, then rising by steps until the coherer reaches the third stage. The coherer can be brought directly to this third stage by a strong impulse, or if the initial applied potential be high. The coherer is sensitive to changes of contact distance of the order of 10^{-7} inch as well as to exceedingly small electrical and mechanical disturbances. The order of distance to which a coherer is sensitive shows that the single-point coherer has no practical existence, it is really a coherer of many contacts. L. H. W.

158. *Rotary Interrupter.* **H. Bordier.** (Archives d'El. Médicale, 11. pp. 219–222, April, 1903.)—This interrupter consists of a ring of copper mounted on a revolving cylinder of wood. At its lower half the copper is cut away so as to leave only two vertical strips opposite each other on the wooden cylinder. A carbon brush carries the current to the copper ring with which it is in contact above, and a similar brush makes contact with the vertical strips. The current is therefore made and broken twice each time the cylinder revolves. To diminish sparking the apparatus is immersed in oil, and a condenser of one microfarad capacity is placed in shunt to the brushes. The cylinder is driven by a motor capable of producing 6,000 r.p.m., and consequently 200 interruptions of the current per second. H. W. P. Y.

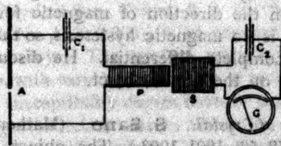
159. *Quadrant Electrometer.* **E. Orlich.** (Zeitschr. Instrumentenk. 23. pp. 97–118, April, 1903. Communication from the Physikalisch-Technische Reichsanstalt.)—The author gives a very thorough discussion of the theory of the Quadrant Electrometer, comparing it throughout with experimental results. The many possible arrangements of the needle, case, and quadrants, and their potentials are gone into, and their use in the determination of the

several constants of the instrument explained. An equation for the deflection in terms of potentials, and nearly a dozen constants, is the result. Two methods of measuring alternate currents are given, as well as several other applications of the electrometer. J. E.-M.

160. *Regulation of Ships' Compasses.* **H. Meldau.** (Phys. Zeitschr. 4. pp. 376–379, April 1, 1903.)—Sabine, in 1849, introduced measurements of the horizontal force into the methods of regulating compasses. Fournier, in 1878, perfected a method depending on this principle, and since that time the construction and use of deflectors for this purpose have become more and more simple and practical. The advantage of this method of regulating a compass lies in the rapidity with which it can be carried out and in its independence of astronomical or terrestrial landmarks, so that it may be completed in fog or bad weather. All deflectors consist of a magnetic system placed on the binnacle over the centre of the card. Its magnetic moment is capable of variation by some means or other. The deflector is movable about the axis of the binnacle, and is either turned through a certain angle from its original N. and S. position, or is kept at a given angle relative to the deflected compass needle. Complete descriptions of the theory and use of the Thomson (Kelvin) deflector and of the Clausen system are given. [See also Abstracts Nos. 351 and 842 (1903).] J. E.-M.

ALTERNATING CURRENTS AND MAGNETISM.

161. *Frequency-measurement of Rapidly Alternating Currents.* **J. W. Salomonson.** (Electrician, 52. pp. 126–128, Nov. 13, 1903.)—The author states that he has obtained sinusoidal alternating currents by means of the singing arc, with frequencies up to 400,000 ∿ per sec., in spite of Duddell's opinion that frequencies as high as 100,000 ∿ per sec. cannot be obtained by this means owing to the fact that $\delta V/\delta A$ for an arc becomes positive with very high frequencies (see Electrician 51. p. 902, 1903). He discarded Peukert's method of measuring frequency [see Abstract No. 463 (1903)], which tacitly assumes that the currents are purely sinusoidal. The apparatus used is indicated in the diagram. A is a shunt-regulator arc lamp; P and S the primary and secondary of an induction coil without iron, the secondary of which has its coefficient of self-induction L carefully measured. C_1 and C_2 are adjustable mica condensers of known capacity; G is a hot-wire galvanometer reading up to 0·3 amperes. The capacity in the secondary circuit is carefully varied until the galvanometer indicates a maximum resonance current. As only one maximum is obtained, and this very sharply defined, the primary current must be closely sinusoidal without many harmonics of appreciable amplitude. The frequency is then calculated by the formula $T=2\pi\sqrt{LC}$. Any desired frequency is obtained by adjusting the capacity



in the secondary circuit in accordance with this formula, and then varying the primary circuit to obtain maximum resonance. In order to prove the reliability of this method, the author checked the frequency in a particular case by simultaneously taking a photographic record of the arc as seen in a rotating mirror. Data are given and a photographic record. The electrical method indicated a frequency of 188,000 ∾ per sec., whilst that obtained optically was 188,200 ∾ per sec. The author thinks that there is a critical p.d. or a critical arc length, above which the arc resistance ($\delta V/\delta A$) ceases to be negative, for each particular frequency; and that as the frequency is raised the critical p.d. and arc length diminish, the former being about 35 volts at high frequencies and the latter a few tenths of a millimetre. [See also Abstract No. 463 (1908).] J. D. C.

162. *Induction-Coil Current Shapes.* **H. Armagnat.** (Écl. Électr. 57. pp. 241–255, Nov. 14, 1908.)—The paper contains a number of reproductions of curves taken by means of a Blondel oscillograph at the instant of breaking the primary circuit, and representing, respectively, the variations, in the primary current, in the magnetic flux, and in the p.d. at the primary terminals. From the study of curves taken under various conditions, the conclusions are drawn:—that no theory yet developed fully accounts for the phenomena in all their complexity; that the observed damping of the first oscillation is due to the sparking both in the primary and the secondary; that hysteresis plays an important part in the damping of the further oscillations; that the observed oscillations are the resultants of oscillations of several different periods with different rates of damping; that the current in the secondary makes demagnetisation slower, and may interfere with the working of the interruptor; and that the e.m.f.s., both primary and secondary, are independent of the maximum primary current, provided this is sufficiently high, and are functions of the spark-gap resistance. G. W. de T.

163. *Magnetisation of Cubic Crystals.* **S. Sano.** (Mathematical and Physical Soc., Tokyo, 1. 11. pp. 73–76, 1901–1903.)—The writer here discusses Weiss' experiments, showing that the amount of magnetisation in crystals of magnetite depends upon the direction of magnetic force. He deals with a system in which there is no magnetic hysteresis, so that $A d\alpha + B d\beta + C d\gamma$ in usual notation is a complete differential. He discusses also the works of Voigt and Wallerant on the same subject. S. H. B.

164. *Magnetostriction of Crystals.* **S. Sano.** (Mathematical and Physical Soc., Tokyo, 1. 9. pp. 52–56, 1901–1903.)—The object of this paper is to extend the results obtained by Hertz, Heaviside, and Pockels on the magnetostriction of æolotropic bodies, which were limited to the case where the magnetic polarisation is a linear function of the magnetic force, to more general cases. But the writer postulates that there shall be no magnetic hysteresis or time lag in the medium considered. He also confines himself to the investigation of isothermal changes and infinitesimal strains. The crystal is supposed to be coated with a stratum of air, such that the substance may be considered to change continuously. It is placed in presence of a permanent magnet. Then if W denote the work done by external forces to magnetise the system, two expressions are found for W in terms of the magnetic force (α, β, γ), and magnetic induction (a, b, c), by the equation of which the result is obtained. Any vertical change δ of position of an element of the system consists of four parts, namely, δ, that due merely

to linear displacement of the element x, y, z considered, δ_2 that due to the rotation of the element, δ_3 that due to the change of distortion produced by the displacement, and δ_4 that due to the change of the magnetic force. Then he finds $\delta W = -\frac{1}{4\pi}\int(\delta_1\psi + \delta_2\psi + \delta_3\psi)d\tau$, where $\psi = \int(a\,d\alpha + b\,d\beta + c\,d\gamma)$. The other expression for δW is $\delta W = -\int(X\,du + Y\,dv + Z\,dw/d\tau$, where X, Y, Z are the components of the mechanical force per unit of volume due to the magnetic field. The analysis leads the author to the conclusion that since the magnetic force is an axial vector, crystals can be divided into eleven distinct groups. S. H. B.

165. *The Wiedemann Effect.* **K. Honda and S. Shimizu.** (Mathematical and Physical Soc., Tokyo, 1. 11. pp. 70–78, 1901–1903.)—This is a study of the influence of tension on the Wiedemann effect in nickel, cobalt, iron and nickel-steel, the diameter of rods used varying from 1·0 cm. to 0·05 cm. It is found that tension diminishes the twist in proportion to the applied tension, but there is never a reversal of twist due to this cause. In cobalt the Wiedemann effect is reversed when the longitudinal field is increased sufficiently. This result is just what would be expected from the magnetostriction experiments. P. E. S.

166. *Magnetization of Iron, Nickel, Cobalt, and Steel near the Critical Temperature.* **H. Nagaoka and S. Kusakabe.** (Mathematical and Physical Soc., Tokyo, 1. 13. pp. 97–100, 1901–1903.)—(1) Whereas the pure metals have simple curves for susceptibility, the steels generally show several maxima and minima closely related to recalescence. (2) The critical temperature is higher in strong fields. (3) The critical temperatures for *heating* and *cooling* sometimes differ by 200°. The critical temperatures by heating for moderate fields are Fe (780°), Ni (430°), Co (1100°), Steel (800°), Wolfram Steel (900°). Wolfram steel shows recalescence in a very striking way, suggesting a good lecture experiment. P. E. S.

167. *Magnetostriction of Nickel Steels.* **H. Nagaoka and K. Honda.** (Mathematical and Physical Soc., Tokyo, 2. 2. pp. 9–15, 1903.) In a former paper [see Abstract No. 1549 (1902)] is an account of experiments on four specimens of these alloys. The present work is more complete since a graded set of twelve, with varying percentage of nickel (24 per cent. to 70 per cent.) is used. The susceptibility curves have at least two maxima and two minima. The magnetostriction curves show in some cases two, and in some cases three maxima and minima. The curve for the volume change by magnetization is simple, showing one maximum. [See also Abstract No. 581 (1903).] P. E. S.

168. *Experiments in Magnetic Moment.* **W. P. Beck.** (Phys. Rev. 16. pp. 224–229, April, 1903.)—The author studies the effect of bending, twisting, concussion and change of temperature on the magnetic moment of a bar magnet, the readings being taken from a magnetometer. The results obtained are summarised as follows: (1) Bending tends to decrease the moment. (2) There is a loss in moment by twisting, which is not regained when the torsion ceases. As regards concussion no regularity was observed in the falling off of the deflections, blows of a certain intensity having a greater proportional effect, but if all the blows are of about the same intensity, the first will produce by far the greatest effect. L. H. W.

169. *Magnetic Elements at Potsdam in* 1901. **A. Schmidt.** (Ann. d. Physik, 10. 4. pp. 890–898, March, 1903. Communicated by the Kgl. Preuss Meterologisches Institut.)—Of the mean values for the year, derived by Edler from the hourly records, the declinations could have been predetermined by formula, the inclinations less well; the intensity values differ noticeably from the uncertain means of 1900. Edler has made accurate determinations of the magnetic elements at 93 stations in northern and north-western Prussia. H. B.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

170. *Application of the Electrolytic Dissociation Theory to Medicine.* **W. D. Bancroft.** (Electrochem. Ind., Philadelphia, 1. pp. 305–307, May, 1903. Lecture delivered before the American Philosophical Society, March 20, 1903.) —If a certain metal is toxic, while the undissociated salt is not, one would expect to obtain the greatest toxic action for a given concentration when that metal is present in the form of a highly dissociated salt. The greater bactericidal action, to some forms of bacilli, of mercuric chloride or bromide solutions as compared with solutions of mercuric cyanide, is explained as being due to the fact that the concentration of mercury as ion is much less in the latter than in the former. Other factors must be taken into account beside that of the electrolytic dissociation. The disinfecting power of carbolic acid is increased by adding sodium chloride, and decreased by sodium acetate. This is because sodium chloride decreases the solubility of carbolic acid, increasing its chemical potential, and consequently its disinfecting power, while sodium acetate has the reverse effect. The properties of a substance are a function of the degree of saturation as well as of concentration. Hoffmann has shown that the accelerating action of acids on certain reactions such as the digestion of proteids by pepsin, is approximately proportional to the concentration of hydrogen as ion. The substitution of acetic acid for hydrochloric acid in the stomach would enormously lengthen the process of digestion. H. W. P. Y.

REFERENCES.

171. *Radium.* **R. J. Strutt.** (Phil. Mag. 6. pp. 588–589, Nov., 1903.)—An account of an experimental method of showing the loss of negative electricity by radium, which may be exhibited in a lecture experiment. J. J. S.

172. *Electrical Dissipation of Fog.* **O. J. Lodge.** (Phys. Soc., Proc. pp. 125–126; Discussion, pp. 126–128, Nov. 13, 1903.)—The author describes some recent experiments on fog dispersion, on a comparatively large scale, by means of a rectified spark discharge obtained by means of a Cooper-Hewitt interrupter from a high-frequency alternator. G. W. de T.

173. *Pressure Observations in a Mercury Vapour Lamp.* **J. Stark** and **M. Reich.** (Phys. Zeitschr. 4. pp. 321–324, March 1, 1903.)—The pressures at anode and kathode due to the streaming of vapour from anode to kathode are measured by a special manometer. P. E. S.

174. *Constant Cells.* **O. Hildebrandt.** (Centralblatt Accumulatoren, 4. pp. 249–251, Nov. 1, and pp. 265–268, Nov. 15, 1903.)—An account of the development of constant cells from the time of Faraday to the present day. Incidentally the "passivity" of metals is dealt with. D. H. J.

175. *Electric Separation of Metallic Powders.* **D. Negreano.** (Comptes Rendus, 136. pp. 964–965, April 20, 1903.)—A description of a method in which a Wimshurst machine is used to effect separation of such powders. [See also Abstract No. 1044 (1903).] J. W. P.

176. *Electrical Measuring Instruments.* **C. D. Haskins.** (Frank. Inst., Journ. 155. pp. 81–96; Discussion, pp. 96–101, Feb., 1903.)—The author, who has had an extensive experience in the construction of electrical measuring instruments, gives a very detailed classification of the different types now in use, based on the physical principles involved. Various points of importance to the designer of such instruments are discussed. G. W. DE T.

177. *Demagnetising Factors of Circular Rods.* **H. du Bois.** (Ann. d. Physik, 7, 4. pp. 942–943, April 8, 1902.)—This is a reply to a paper on the same subject by C. Benedicks. [See Abstract No. 503 (1902).] The author disagrees with Benedicks' assertion that Mann's figures should all be increased by a small amount (0·002). L. H. W.

178. *Magnetic Expansion of Some of the Less Magnetic Metals.* **P. E. Shaw.** (Roy. Soc., Proc. 72. pp. 370–374, Nov. 21, 1903.)—This is an account of tests for magnetic expansion applied to bismuth, silver, aluminium, copper, zinc, brass, bronze, lead, and tin, for fields up to 1,900 c.g.s. No change in length was detected. [See also Abstract No. 1553 (1902).] W. S.

179. *Magnetic Expansion of Some of the Less Magnetic Metals.* **G. A. Schott.** (Roy. Soc., Proc. 72. pp. 375–378, Nov. 21, 1903.)—This article contains the mathematics of the experiments referred to in the preceding Abstract. W. S.

180. *Dispersion of Atmospheric Electricity on Capri.* **V. Cuomo.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 104–120, 1903.)—This is a continuation of a former paper [see Abstract No. 931 (1903)], covering the period October, 1902, to February, 1903. H. B.

181. *Electric Potential on the Sonnblick.* **V. Conrad** and **F. M. Exner.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 413–419, April–June, 1903.)—A Benndorf recording instrument was mounted on the Sonnblick (3,106 m.) from June to August, 1902. The atmospheric potential curves mark periods both of 24 and of 12 hours (amplitude ratio 9 : 14), and further very rapid and frequent changes in the values of the potential. H. B.

182. *Explosive Action of Lightning.* **R. A. West.** (Nature, 69. p. 31, Nov. 12, 1903.)—The author refers to a case where a length of 15 feet was struck off the top of a cedar tree by lightning; the trunk was split, and a steam cloud was observed. The author suggests an electrostatic side-splash effect. H. B.

183. *Magnetic Observatories of the United States.* **L. A. Bauer** and **J. A. Fleming.** (Terrestrial Magnetism, 8. pp. 10–29, March, 1903 (Abstract).)—The authors describe the four magnetic observatories of the U.S. Coast and Geodetic Survey in operation on July 1, 1902, situated at Cheltenham, Ind., 14 miles from Washington, the standard observatory; at Sitka, Alaska; at Honolulu, Hawai, on an immense coral plain; and at Baldwin, Kansas (temporary observatory). H. B.

184. *Magnetic Storms, Auroræ, and Solar Phenomena.* **W. J. S. Lockyer,** (Nature, 69. pp. 9–10, Nov. 5, 1903.)—Comments on the magnetic storm of Oct. 31; further magnetic storms may be expected until 1906 or 1907. H. B.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

185. *Direct Combination of Chlorine with Carbon.* **W. v. Bolton.** (Zeitschr. Elektrochem. 9. pp. 209–210, March 5, 1903.)—In a large vessel containing chlorine, the luminous arc forms hexachlorethane [see Abstract No. 1758 (1902)], but if a small vessel is used, and the gas formed led often and rapidly through the arc, it yields hexachlorobenzene; this compound appears to be formed only at the positive carbon. T. H. P.

186. *Electro-chemistry of Permanganic Acid.* **J. H. K. Inglis.** (Zeitschr. Elektrochem. 9. pp. 226–230, March 12, 1903.)—When an electrode coated with manganese peroxide is immersed in a permanganic acid solution, the change taking place is given by: $MnO' + 4H^{\cdot} = MnO_2 + 2H_2O + 3\oplus$, whilst in a manganous salt, the reaction is: $MnO_2 + 4H^{\cdot} = Mn^{\cdot\cdot} + 2H_2O + 2\oplus$. The potentials P_1 and P_2 of the electrode in the two cases are given by the expressions—

$$P_1 = P_1' + \frac{RT}{3F} \log \frac{C_{MnO_4'} \times C^4_{H^{\cdot}}}{C_{MnO_2} \times C^2_{H_2O}}$$

and

$$P_2 = P_2' + \frac{RT}{3F} \log \frac{C_{MnO_2} \times C^4_{H^{\cdot}}}{C_{Mn^{\cdot\cdot}} \times C^2_{H_2O}}$$

where P_1' and P_2' are the potentials when all the concentrations are unity. The experimental values obtained by the author agree with these relations. The reactions represented by the above equations are the two stages in the total change given by: $MnO_4' + 8H^{\cdot} = Mn^{\cdot\cdot} + 4H_2O + 5F$, and the potential P_3 of a platinum electrode at which this reaction is going on should be connected with P_1 and P_2 by the relation: $P_1 = (3P_2 + 2P_3) \mid 5$. With a solution containing $H_2SO_4 \mid 20 + MnSO_4 \mid 10{,}000$ per litre, P_2 is 1·602 volts, and with $H_2SO_4 \mid 20 + KMnO_4 \mid 100$ per litre, P_1 is 1·771 volts, so that, with $H_2SO_4 \mid 20 + MnSO_4 \mid 10{,}000 + KMnO_4 \mid 100$ per litre, P_3 should be, from the above relation, 1·703 volts. The value obtained is always greater than this and increases with time, owing to the oxidation of manganous ions: $2Mn\dot{O}' + 3Mn^{\cdot\cdot} + 2H_2O = 5MnO_2 + 4H^{\cdot}$. It is found by calculation that $Mn^{\cdot\cdot}$ ions can only exist in presence of permanganate ions in very small quantity (about 10^{-10}). This explains why the potential of a platinum electrode in an acid potassium permanganate solution containing a manganous salt cannot be measured, as it is so extremely readily polarised. T. H. P.

187. *Rate of Crystallisation and Temperature.* **W. Borodowsky.** (Zeitschr. Phys. Chem. 43. pp. 75–88, March 13, 1903.)—It has been shown by Tammann and his pupils that for a certain temperature interval below the freezing point, the rate of crystallisation of a substance is proportional to the amount of the supercooling; at lower temperatures this proportionality disappears, and at still lower temperatures the rate diminishes rapidly. With substances having a rapid rate of crystallisation the middle part vanishes so that a sharply defined maximum is obtained. The author's experiments, made with *p*-nitro-phenyllactic acid ketone, salipyrine, peucedanin, forma-

nilide, and orthophosphoric acid, give the following results: For these substances, which crystallise slowly, the maximum rate of crystallisation lies generally (except for salipyrine-1 and orthophosphoric acid-2) 15° to 20° below the melting point, provided the tubes employed are of about the same bore, and from the melting point to this maximum, the rate increases very nearly proportionally to the amount of supercooling. Direct observations on the crystallisation and on the shape of the meniscus show that, before the maximum point is reached, some of the supercooled liquid remains between the crystals, whilst at temperatures below that of the maximum rate the solidification is nearly or quite complete. Impurities diminish the rate of crystallisation, their effect being greatest between the melting and maximum-rate points. On diminishing the bore of the tube, the influence of the heat of crystallisation on the rate thereof becomes smaller, so that the maximum point is displaced towards higher temperatures. The author finds that there are two different modifications of salipyrine having different melting points [(1) 91·8° and (2) 86·3°] and rates of crystallisation. The same is the case with orthophosphoric acid which forms transparent crystals melting at 36·6°(2), and milk-white crystals, melting at 41°(1) and passing readily into the other form at low temperatures. T. H. P.

188. *Reduction of Metallic Halogens by Hydrogen.* **A. Jouniaux.** (Comptes Rendus, 136. pp. 1003–1005, April 27, 1903.)—The reaction is made to take place in an enclosure: when equilibrium is established four substances exist in presence of each other; the halogen and the metal, the hydracid and hydrogen. The proportion of the hydracid found is greater as the initial pressure of the hydrogen gas is less. The experimental results of the reduction by hydrogen of silver chloride, silver bromide, silver iodide, lead chloride, lead bromide, and lead iodide, are given. J. J. S.

189. *Passive State of Iron.* **C. Fredenhagen.** (Zeitschr. Phys. Chem. 43. pp. 1–40, March 13, 1903.)—After noticing the observations of Faraday and Hittorf [see Abstract No. 2283 (1900)] on the passive state in iron, the author proceeds to investigate its production by electrolysis, taking into consideration the similar work of Finkelstein [see Abstract No. 747 (1902)]. The author places a small rod of iron as anode in N/10 sulphuric acid, together with a large sheet of platinized platinum, and finds the e.m.f. of the iron to be 0·625 volt. On connecting this with an external e.m.f., the iron continues to dissolve, but without evolution of gas. He now measures the e.m.f. of the iron and the current passing through the cell after successive increments of the external e.m.f. The e.m.f. of the iron falls till it reaches —0·28 volt, when the current almost disappears and the iron ceases to be dissolved. Finally the e.m.f. of the iron sinks to —0·728 volt, with a polarising e.m.f. of 1·08 volt; during this period, gas bubbles appear on the iron, which behaves as an unattackable or oxygen electrode. The oxygen-concentration in the region of the anode is at a maximum. On allowing the polarising e.m.f. to fall, the iron remains in this passive condition till 0·54 volt is reached. At the same time the gas-concentration decreases and the e.m.f. of the iron rises to —0·24 volt. At this point the iron suddenly behaves as an attackable electrode, and the cycle can be repeated. In these circumstances the iron is active when the polarising e.m.f. is below 0·54 volt and passive when it rises above 1·08 volt. The author regards this behaviour to be due to the occlusion of oxygen in the molecular surface of the iron. During the active phase the hydrogen liberated by the chemical action of the acid unites with the oxygen

produced by the current. When the oxygen is in excess, it is occluded by the iron. The small amount of current passing is now sufficient to maintain the oxygen concentration and the passive state, so long as the polarising e.m.f. does not fall below 0·54 volt. If the acid is replaced by normal caustic soda, the iron behaves as if passive under all conditions. In double-normal nitric acid a polarising e.m.f. of 1·38 volt is required to bring about the passive state, which is retained till the e.m.f. is allowed to fall to zero. This different behaviour may be due to the occlusion of oxides of nitrogen instead of oxygen. The author uses these results to explain certain periodic phenomena observable with iron in different solutions of metals and acids. [See also Abstract No. 1720 (1901).] F. S.

190. *Numerics of the Elements.* **E. J. Mills.** (Phil. Mag. 5. pp. 543–549, May, 1903.)—The atomic weights of the elements may all be calculated from an expression of the form: $y = pn - n[n/(n+1)]^x$, where p represents the number of the periodic group containing the element considered, $n+1$ the number of periods in the system, and x the integral ordinal within a given group. The author shows that the values so calculated agree well with the most recent values assigned to the atomic weights. The number 15·94 is considered to be the most probable value for the atomic weight of oxygen, and this is taken as the standard. The order of agreement may be seen for the following numbers obtained as above and by experiment for the atomic weights of the elements of Group III.:—

	x.	y (By Experiment).	y (Calculated).
P	1	30·96	30·94
S	2	31·98	31·82
Cl	7	35·37	35·45
K	14	39·02	38·92
Ar	16	39·76	39·66
Ca	17	39·90	39·99
Sc	42	43·98	44·00

T. H. P.

191. *Influence of Inorganic Salts on Solubility.* **W. Biltz.** (Zeitschr. Phys. Chem. 43. pp. 41–48, March 13, 1903.)—The solubility of phenylthiocarbamide in water at 20° was found in agreement with Rothmund [see Abstract No. 1699 (1900)] to be 13·935 millimol. per litre. This is decreased as a rule by the addition of inorganic salts. The magnitude of this effect decreases in the series Na, K, Li, Rb, NH_4, CO, and in the series Cl, NO_2, ClO_3, NO_3, ClO_4, I, and an increase of solubility is produced by $RbNO_3$, NH_4NO, $CsNO_3$, NaI and KI at all concentrations, and by KNO_3, KNO_2, $NaNO_2$ and $NaClO_4$ at small concentrations. The magnitude of the effects produced by different salts does not agree with that observed in other properties of aqueous salt solutions, which give for instance the series Li, Na, NH_4, K, Rb, Cs for the alkali metals. T. M. L.

192. *Rate of Oxidation of Potassium Iodide by Chromic Acid.* **R. E. De-Lury.** (Journ. Phys. Chem. 7. pp. 239–253, April, 1903.)—The author has investigated the rate of oxidation of potassium iodide by chromic acid (bichromate and sulphuric acid), and found that at 30° the rate is nearly proportional to the concentration of the *bichromate* and to the square of the concentration of the *acid*. The relation between the rate of oxidation and the concentration of the *iodide* can be expressed by an equation of the form $R = mC + nC^2$. A repetition of some of the experiments at 0° proved that the temperature coefficient of the reaction is unusually low. Ferric salts, when present, appear to modify the rate. D. H. J.

193. *Nitromethane as a Solvent.* **L. Bruner.** (Ber. Deut. Chem. Gesell, 36. pp. 3297–3298, Oct. 24, 1903.)—The high dielectric constant, 56·4, of nitromethane, suggests that this should be an ionising solvent. The lowest conductivity of the solvent was $0\cdot64 \times 10^{-6}$ reciprocal ohms. Potassium chloride and iodide, ammonium bromide and iodide, and the chlorides and iodides of many organic bases were insoluble in nitromethane, but antimony chloride and bromide, mercuric chloride and tribromoacetic acid were soluble and gave conducting solutions. The highest value of the molecular conductivity was $\mu = 2\cdot25$ at $v = 128$ litres for antimony tribromide, and the conductivity is therefore far smaller than the dielectric constant would indicate. T. M. L.

194. *Facts about Bismuth Oxide.* **W. Guertler.** (Zeitschr. Anorg. Chem. 37. 1. pp. 22–24, Oct. 27, 1903.)—When melting bismuth oxide obtained by heating the basic nitrate to redness, the crystallised mass is found to glow during the cooling, this phenomenon (evidencing the formation of a second allotropic modification) commencing from the peripheral portions of the mass and being propagated with a velocity depending on the amount of liquid oxide used. By means of thermo-elements, the temperatures of the melting and conversion points were determined, when the temperature of 704° was found to correspond with the transition point from modification (1) into the form (2). On repeating these experiments in porcelain crucibles rather different results were obtained, the fused mass crystallizing in long bright yellow needles. This third modification is found not to have any transition-point; it possesses a higher melting point and is more stable. (2) The rate of dissolution in acids is found to be different for the two former modifications, and the following figures are found for the specific weights of the modifications (2) and (3); viz., $8\cdot20 + 0\cdot10$ and $8\cdot55 + 0\cdot05$, respectively. A. G.

195. *Distillation in Exhausted Quartz Vessels.* **A. Schuller.** (Zeitschr. Anorg. Chem. 37. 1. pp. 69–75, Oct. 27, 1903.)—The author has carried out distillations of scarcely volatile bodies, in a vacuum, using quartz vessels, which may be raised to temperatures about 800° above the limiting temperature of glass vessels. In cases where the body melted in the quartz vessel adheres to the walls of the vessel, so as to produce cracks, the substance should be surrounded by a metal or glass envelope to prevent it from so sticking. The experiments recorded in this paper were made with a view to ascertaining the volatility of the specimens, viz., the lowest temperature at which any volatility may be observed. The author shows, for instance, silver to be distinctly volatile, even in the solid state; a sublimation of copper was obtained with quartz vessels. Thin layers of both of these metals present different colorations. As regards gold, experiments go to show that this metal in the liquid state is volatile even at the melting point, or at least in its neighbourhood, pure gold giving in a distilling tube an appreciable deposit after from one to two days. Tin, a metal never distilled in glass vessels, was distinctly vaporised and precipitated in quartz tubes, most probably below the melting-point of gold. A. G.

196. *Electromotive Force of Calomel Cells.* **J. N. Brönsted.** (Zeitschr. Anorg. Chem. 37. 1. pp. 158–164, Oct. 27, 1903.)—The electromotive force of two cells of the calomel type connected in opposition is shown to be dependent only: (1) On the relative amount of the concentration of the ions with easily soluble salts. (2) On the valency of the kation, and (3) on the valency of the anion. On the other hand, it is shown to be wholly independent of the valency of the second metal and the number of ions produced by the distillation of the easily soluble salt, provided the valency of both the kation and anion varies independently of this number. This law, however, ceases to be true for even moderately dilute solutions, being exact only in the case of very dilute solutions. A. G.

197. *Theory of Mechanical and Colloidal Suspensions.* **J. Billitzer.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1393–1432, Oct. and Nov., 1902.)—The author first gives a short description of the principal properties of mechanical and colloidal suspensions, and then discusses the various theories which have been advanced with regard to their nature. According to the author's views, solutions of "true" colloids—that is, those which are precipitated by the addition of small quantities of an electrolyte—represent a kind of extremely fine suspensions, the separate particles of which stand in electrical contrast to the surrounding medium. These views are supported by a number of experiments, for a description of which reference must be made to the original. [See also Abstract No. 749 (1903).] T. H. P.

198. *Theory of Polarisation-capacity.* **F. Krüger.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 59–74, 1903. From the Institut für physik. Chemie an der Univ. Göttingen.)—After referring to the theories of Kohlrausch and Warburg, and to previous experimental work on the subject of electrode capacity, the author develops his own theory (which is founded on the views of Nernst and Hehmholtz), and supports it by numerous experiments. It is not possible in a brief review to do more than direct the attention of electrical engineers and electrochemists to this very important paper. F. G. D.

199. *Equilibrium in the Reaction; $CO_2 + H_2 = CO + H_2O$.* **O. Hahn.** (Zeitschr. Phys. Chem. 42. pp. 705–708, March 8, 1903.)—The author describes experiments in which mixtures containing various proportions of the reacting gases were passed through vessels furnished with capillary entry and exit tubes, and containing platinum, either in a finely divided state or in the form of thin foil. In each separate experiment, the rate of flow of the gaseous mixture was diminished until an alteration in the rate produced no change in the composition of the system. The following are the values obtained for the equilibrium constant, $K = [CO][H_2O]/[CO_2][H_2]$:—

Temperature.	K (found).	K (calculated).
786° C.	0·81	0·80
886°	1·19	1·15
986°	1·54	(1·54)
1,005°	1·68	1·62
1,086°	1·95	1·96
1,205°	2·10	2·49
1,405°	2·49	3·37

From van't Hoff's equation: $d(\log_e K)/dT = -q/RT^2$, taking $q = -10232 + 0{\cdot}1685\,T + 0{\cdot}00101\,T^2$ (for which the data of Berthelot and of Mallard and Le

Chatelier were employed) and using the experimental value for K at 986° for determining the integration constant, the calculated values for K given above were obtained. The deviations between the calculated and found values of K at 1,205° and 1,405° are possibly due to dissociation of the carbon dioxide and water vapour or to displacement of the equilibrium during the cooling.

T. H. P.

200. *Maximum Density of Aqueous Solutions of Organic Compounds.* **W. Müller.** (Zeitschr. Phys. Chem. 43. pp. 109–112, March 13, 1903.)—The majority of organic substances cause a lowering of the temperature of maximum density of water, as is indicated by the following table in which *m* gives the concentration of the solution in gram. molecules per litre, D° the lowering of the temperature of maximum density, and D°/*m* the molecular lowering of this temperature.

	m	D°	D°/*m*
Phenol	0·0459	0·325	7·08
Pyrocatechol	0·0509	0·383	7·52
Resorcinol	0·0509	0·382	7·51
Hydroquinone	0·0509	0·378	7·40
Pyrogallol	0·0428	0·367	8·57
Phloroglucinol	0·0368	0·288	7·82
Mannitol	0·0312	0·349	11·17
Glucose	0·1046	1·070	10·3
Oxalic acid	0·0409	0·497	12·14
Succinnic acid	0·0433	0·536	12·39
Tartaric acid	0·0416	0·636	15·28

Alcohol produces an elevation of the temperature of maximum density.

T. M. L.

201. *Hydrolysis of Urea Hydrochloride.* **J. Walker** and **J. K. Wood.** (Chem. Soc., Journ. 83. and 84. pp. 484–491, April, 1903.)—A comparison method is described whereby the hydrolysis of a salt such as urea hydrochloride, can be determined by the methyl acetate or cane-sugar method within 1 per cent. The method consists in first roughly determining the hydrolysis by the above methods and then comparing the effect of the solution of urea hydrochloride in question on, say, the velocity of inversion of cane-sugar with the effect of a solution of sodium chloride and free hydrochloric acid of the same total "chlorine" concentration, and containing an amount of free acid equal to that found in the solution of urea hydrochloride. In this way allowance is made for change in the degree of electrolytic dissociation of the HCl and for the direct influence of the undecomposed chloride. Within the range 25° – 40°, temperature has practically no influence on the hydrolysis of urea hydrochloride. The dissociation-constant of urea calculated from the hydrolytic experiments is $1·5 \times 10^{-14}$ at 25° C.

F. G. D.

202. *Reliability of the Dissociation-constant as a means of determining the Identity and Purity of Organic Compounds.* **H. Scudder.** (Journ. Phys. Chem. 7. pp. 269–299, April, 1903.)—The author gives a critical and fairly exhaustive summary of the literature bearing on the electrical conductivity of organic acids. His conclusions are as follows: (1) The dissociation-constant

(as measured electrically) is a moderately reliable aid to identification. Its use is however limited. (2) If for any acid the constants found by different observers agree within 10 per cent., the agreement is satisfactory. (3) The agreement between the values of the constants at different dilutions does not give a satisfactory guide to the purity of the compound that is being measured. This fact lessens the reliability of the constant as a means of identification. F. G. D.

203. *Identification of Basic Salts.* **W. L. Miller** and **F. B. Kenrick.** (Journ. Phys. Chem. 7. pp. 259–268, April, 1903. Reprinted from Trans. Roy. Soc. Canada, (2) 7. 35 [1901].)—This is an extremely important paper. The authors show how the phase-rule can be applied to elucidate the composition of the complex mixtures of "basic" salts which occur so frequently in chemistry. After laying down the fundamental principles which must govern systematic research in this direction, the authors illustrate the subject by a brief discussion of the work carried out in their laboratory on the basic nitrates of bismuth by F. B. Allan. Reference is also made to their own work on basic chlorides of lead and to a research on basic chlorides of copper which is being carried out in the physico-chemical laboratory of Toronto University. F. G. D.

204. *Formation of Hydrogen-ions from the Methylene-groupings of Succinic, Malonic, and Glutaric Acids.* **R. Ehrenfeld.** (Zeitschr. Elektrochem. 9. pp. 335–342, April 23, 1903. Communication from the Laboratorium der k.k. Technischen Hochschule in Brünn.)—Weighed quantities of the pure acids dissolved in CO_2-free water were titrated with very carefully standardised sodium hydrate solution, when it was found that the amounts of alkali used differed from the calculated amounts in some cases by as much as 0·5 per cent. The conductivities of solutions of the normal alkali salts of these acids were then measured. Since the product $H^{\cdot} \times OH'$ is a constant, it follows that the addition of small amounts of caustic alkali should affect the conductivity. On adding 1/20 normal and somewhat stronger solutions of caustic alkalies drop by drop to solutions of the respective normal salts there was at first a fall in the conductivity, which was then followed by a gradual increase. The catalytic action of the dissociated hydrogen on the hydrolysis of an ester was investigated by adding normal salts of the acids to the ester and titrating after the lapse of a certain time. The potential of a hydrogen electrode in contact with a solution of salts of these acids was measured, and the results are discussed. F. S.

205. *Melting-points of Calcium and Sodium Silicates and their Mixtures.* **N. V. Kultascheff.** (Zeitschr. Anorg. Chem. 35. 2. pp. 187–194, May 21, 1903.)—The research described in this paper was carried out with the view of ascertaining whether $CaSiO_3$ and Na_2SiO_3 are capable of forming any compounds with one another, melting points (crystallising temperatures) of mixtures of both substances being determined so as to draw, from the possible maxima in the melting curve, some conclusions as to the existence of double salts. To thoroughly mix them, Na_2CO_3, SiO_2 and CaO were fused in a platinum crucible, and the result, after cooling and pulverising, was again fused, this time in a Fourguignon furnace, allowing of temperatures as high as 1,400° being reached. The temperatures were measured by means of a le Chatelier thermo-element, the wires of which were protected against the gases of combustion by a double porcelain tube. The cooling curve for 30 gm. of each of the mixtures was obtained from readings taken at intervals of 10 to 5 seconds. The beginning of crystallisation was noted, with small superfusions the temperature remaining constant during 30–60 seconds. With greater superfusions the temperatures would sometimes rise as much as 100° after crystallisation had begun, and fall about 30 seconds afterwards. The maximum rise in the temperature, or the attainment of a temperature remaining constant during an interval of 30 to 60 seconds, would be taken as the melting-point of the mixture. The melting curve has a maximum at a point corresponding with the temperature 1,160° and a mixture containing 60 per cent. of $CaSiO_3$, this giving evidence of a combination existing at this point (the composition being practically $2Na_2SiO_3$, $3CaSiO_3$). It may, however, be inferred from these data that in cooling mixtures from 60–80 per cent. $CaSiO_3$, instead of the pure compound $2Na_2SiO_3$, $3CaSiO_3$, mixture crystals of this compound with $CaSiO_3$ will be formed. In addition to the determination of melting points, the influence exerted by progressive addition of SiO_2 in excess on the melting point of Na_2SiO_3 and some mixtures was investigated. A. G.

206. *Contribution to the Knowledge of van der Waals' ψ-Surface.* **J. E. Verschaffelt.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 69–77, May 30, 1903.)—The author continues his investigation into the state equation and the ψ-surface, in the immediate neighbourhood of the critical state, of binary mixtures containing small amounts of either of the components, studying the α, β-diagram, and the numerical values of the reduced differential quotients. A. G.

207. *Composition of Chemical Compounds Ascertained without Analysis.* **G. Tammann.** (Zeitschr. Anorg. Chem. 37. 2. pp. 303–314, Nov. 6, 1903.)—The theory of the equilibrium of heterogeneous systems affords a number of methods for deciding as to whether two bodies will form with each other a compound and what the quantitative composition of the latter will be, it being possible to derive answers to these questions from the melting diagrams of two bodies and the dependence of the properties of the crystallised fuses of two bodies on their composition. These methods, described in the present paper, may be used whenever a mechanical separation of the crystals from the fused substance out of which they are formed is practically impossible, as in the case, for instance, of the investigation of the compounds of several metals and the silicates formed from their fuses. It is shown that, provided the temperature of eutectic crystallisation and especially the duration of the latter, are taken into account in designing the melting diagrams, a sufficient number of criteria is arrived at to permit of the composition of the compounds formed being ascertained even in complicated cases. A. G.

208. *Theory of the Critical State.* **J. Traube.** (Zeitschr. Anorg. Chem. 37. 2. pp. 225–243, Nov. 6, 1903.)—In a former paper on the theory of critical phenomena and vaporisation [see Abstract No. 728 (1903)] the author mentioned his hypothesis that in the vaporisation of the liquid, in addition to the co-volume being increased, there would be a material increase in the volume proper of the molecule, the gaseous particles or *gasons* being thus much larger than the liquid particles or *fluidons.* Modern chemistry has shown the liquid molecules to be as a rule identical in weight with gaseous molecules; accordingly the author assumes a difference in the *space* occupied by

the molecule. Gasons would be soluble (above the absolute zero) in the liquid phase, and fluidons in the gaseous phase. Homogeneous liquids would be solutions of gasons in the liquid phase, whereas a saturated vapour should have to be regarded as a solution of fluidons in the gaseous phase. The ratio between the amounts of gasons and fluidons in either of the two phases, as calculated by the author, alters with the temperature, assuming a value of about 2 : 1 at the critical temperature. This theory had been suggested on the basis of recent experiments by de Heen, Dwelshauwers-Dery, Galitzine, Cailletet and Battelli, being in evident disaccord with Andrews' current theory of critical phenomena. The critical temperature, according to the author's and de Heen's views, would be the temperature at which a perfect miscibility of two heterogeneous matters is produced. In the present paper the author shows that his hypothesis, presuming a *discontinuity* of the gaseous and liquid states to exist at the critical temperature, is confirmed also by facts wholly independent of the critical phenomena.

The first evidence is derived from van der Waals' state equation, it being shown that the constant b must be considerably larger in the case of a gas than that of a liquid, independently of any further hypothesis. Like the affinity pressure and the external compression pressure, the internal pressure $a : v^2$ must diminish this constant. Now this internal pressure is little variable along with temperature for temperatures distant from the critical temperature as long as the substance in question does not pass into the gaseous state. There must therefore occur a discontinuous and rather material increase in the volume of the coefficient b on the passage from the solid or liquid into the gaseous state, *i.e.*, gasons must be considerably larger than fluidons. The alteration of b for liquids for variable temperatures, viz., internal pressures variable along with the latter, may occur in two different ways, according as either all the fluidons increase uniformly with increasing temperatures, or only part of the fluidons are converted into gasons with a considerable increase in volume, each temperature corresponding to a given ratio of gasons and fluidons. Of these two hypotheses the author is inclined to adopt the second. Van der Waals' state equation will thus assume a considerably higher importance, as the behaviour of the factor b is accurately ascertained. The passage of a fluidon into the state of a gason would be attended by an increase in pressure corresponding with the middle part of the isothermals requiring *an increase* in pressure for *increasing* volumes. Teichner has suspended small glass balloons of different and given densities in a tube filled with pure carbon chloride at the critical temperature, when the balloons would be kept even for several degrees above the critical temperature at different heights corresponding with their density and the density of the contents of the tube, giving evidence of differences in density as high as about 50 per cent., though 3 zones could be distinctly noted in the tube. There must accordingly, at the critical temperature, co-exist, in opposition to Andrews' theory, two different matters, critical temperature being the one at which both matters are soluble in each other in any ratio. A. G.

209. *Action of Hydrogen Peroxide and Sodium Hypochlorite on the Oxides of Thorium, Zirconium, and Cerium.* **L. Pissarjewsky.** (Chem. News, 88. p. 249, Nov. 20, 1903. Journ. Soc. Phys. Chem. R. 34. p. 488.)—Hydrogen peroxide gives with solutions of thorium nitrate precipitates of the compound, $Th(O_2H)_4$, or mixtures of this salt with its products of hydrolytic dissociation, $Th(O_2H)_3OH$, $Th(O_2H)_2(OH)_2$, $Th(O_2H)(OH)_3$. $Th(O_2H)_4$ may be regarded as the normal thorium salt of the feeble acid $H . O_2H$. Similar results are obtained with solutions of zirconium nitrate. Solutions of cerous sulphate gave also precipitates of a similar character, but they do not appear to have been analysed. The action of sodium hypochlorite is analogous to that of hydrogen peroxide. The peroxides of Th and Zr are best prepared by electrolysing an alkaline solution of NaCl in which the oxides of Th and Zr are suspended. Continual agitation of the liquid is necessary. F. G. D.

210. *Acetylene as a Depolarising Agent.* **J. Billitzer** and **A. Coehn.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1433–1443, Oct. and Nov., 1902.)—This paper is a more complete account of the author's work, a shorter description of which appeared earlier in the Zeitschr. Elektrochem. [see Abstract No. 1744 (1901)]. Further results are described. Attempts were made to form halogen compounds with acetylene by passing the latter over platinum anodes during the electrolysis of electrolytes containing these elements. With alkaline solutions of the halogens decided depolarisation took place, but this was not due to the direct action of the halogens, oxalic acid being one of the two compounds formed. Halogen acids exhibited no distinct lowering of the discharge potential until phosphorus tribromide was added, when two lower values were obtained, corresponding to two depolarisation products. The separation and examination of these was reserved for future investigation owing to the difficulties involved. In order to obtain electrolysis neutral at the beginning and increasing comparatively slowly in alkalinity as electrolysis proceeds, ammonium bromide and iodide were used with platinised platinum electrodes. Direct action of the halogen with acetylene at the anode was then obtained. Two products were formed with distinct lowering of the discharge potential of the electrolyte to two new values. These products were light liquids possessing an etheric odour. Owing to the difficulty of separating them, the authors confine themselves to stating that their boiling-points were in the neighbourhood of those of the addition products of bromine and iodine with acetylene. J. D. C.

211. *Catalysis of Hydrogen Peroxide by Iodine Ions.* **G. Bredig** and **J. H. Walton, Jr.** (Zeitschr. Elektrochem. 9. pp. 114–119, Feb. 5, 1903.)—The catalytic decomposition of hydrogen peroxide in presence of iodides is a reaction of the first order and is proportional to the concentration of the iodine ions, as was shown in the case of solutions of sodium, potassium, and cadmium iodides. Neither potassium iodate nor potassium periodate increases the catalytic action of the potassium iodide on the hydrogen peroxide, so that the iodide does not act in consequence of an intermediate formation of iodate or periodate. On the other hand, the alkaline reaction of a solution of KI and H_2O_2 points to the mediary formation of hypoiodite. The latter, however, as a conductivity determination shows, exists in the solution only in very small quantities, since it at once reacts with hydrogen peroxide to form iodine ions and free oxygen. We may therefore represent the decomposition in two stages: (1) $H_2O_2 + I' = H_2O + IO'$; (2) $H_2O_2 + IO' = H_2O + O_2 + I'$. The second reaction is almost instantaneous, so that the velocity of the first only comes to be measured. D. H. J.

212. *Electrolysis of Alkali Chloride Solutions.* **F. Foerster** and **E. Müller.** (Zeitschr. Elektrochem. 9. pp. 171–185, Feb. 26; and pp. 195–208, March 5, 1903. From the Elektrochemisches Laboratorium der Technischen

Hochschule, Dresden.)—The theory of the action of halogens on alkalies put forward by the authors [see Abstract No. 948 (1903)] is applied to the phenomena occurring at the anode when a solution of an alkali chloride is electrolysed. The conclusions arrived at are briefly as follows: (1) In the electrolysis of an aqueous solution containing chlorine ions, free chlorine is formed at the anode: $Cl' + Cl' + 2\oplus = Cl_2$. (2) At the same time hypochlorous acid and hypochlorite ions are also formed at the anode, either according to the equations: $Cl' + OH' + 2\oplus = HOCl$ and $Cl' + 2OH' + 2\oplus = ClO + H_2O$, or by equilibrium being set up between the chlorine liberated and the OH' present at the anode, thus: $Cl_2 + OH' \rightleftarrows HOCl + Cl'$ and $HOCl + OH' \rightleftarrows ClO' + H_2O$. As the concentration ratio OH'/Cl' increases (with stronger alkaline or dilute solutions) at the anode, the concentration, at the latter, of ClO' increases. (3) Hypochlorite is also formed in the electrolyte by the action of the anodic chlorine on the alkali present. (4) Since ClO' is relatively more readily discharged (and so destroyed) than Cl', the hypochlorite formed at the anode can never attain a high concentration in the electrolyte, and the farther away from the anode it is formed, the more can it persist in the electrolyte. (5) Chlorate or chloric acid is formed by the discharge of ClO' at the anode: $6ClO' + 3H_2O + 6\oplus = 2ClO_3' + 4Cl' + 6H' + 3O$, or by the occurrence in the electrolyte of the secondary reaction: $ClO' + 2HClO = ClO_3' + 2H' + 2Cl'$. (6) The anodic formation of chlorate is always accompanied by the evolution of oxygen. It is conditioned by a ClO' concentration corresponding with the anode potential given by the chloride and the alkali contents of the solution and by the constitution of the electrodes. (7) The requisite amount of ClO' for a given potential may either be formed at the anode or diffuse to it from the electrolyte; in the former case (occurring with strongly alkaline or dilute chloride solutions or dilute hydrochloric acid), chlorate is obtained from the beginning of the electrolysis, whilst in the latter (stronger neutral solutions) it only appears when electrolysis has been in progress for some time. (8) In strongly alkaline chloride solutions or in very dilute, neutral, or acid solutions, anodic evolution of oxygen is also brought about by the discharge of OH'. (9) The secondary formation of chlorate proceeds without disengaging oxygen and takes place to an appreciable extent only when free hypochlorous acid and hypochlorite exist together in a large part of the electrolyte, *i.e.*, when only a small quantity of acid is added to the chloride solution. [See also Abstract No. 526 (1903).] T. H. P.

213. *Equivalent Conductivity of the Hydrogen Ion from Transference Experiments with Hydrochloric Acid.* **A. A. Noyes** and **G. V. Sammet.** (Zeitschr. Phys. Chem. 43. pp. 49–74, March 13, 1903.)—The authors give the results of a number of transference experiments on hydrochloric acid solutions made in the apparatus previously described by them, a round silver plate being employed as anode in order to prevent the introduction of foreign salts into the solution. After passing a current (measured by a silver voltameter) for three hours through an accurately adjusted solution (N/20 or N/60) of hydrochloric acid at constant temperature, the alteration of composition of the anodic, kathodic, and interior portions of the liquid was determined by titration with baryta and by precipitation with silver nitrate. The mean transference numbers (multiplied by 1,000) thus obtained are: at 20° for the N/20 solution, 165·69, with an average deviation of 0·12, and for the N/60 solution, 167·48, with an average deviation of 0·25; at 10°, for the N/60 solution, 158·62, with an average deviation of 0·15; at 30°, for the N/60 solution,

177·34, average deviation 0·16. The real error is probably not greater than 0·45 per cent. It is uncertain how far the difference obtained between the transference numbers at 20° for the N/20 and the N/60 solutions is a real one and not depending on experimental error, but the numbers show that the transference numbers for infinite dilution cannot differ greatly from that for the N/60 solution.

Measurements of the conductivity of N/58 and N/252 hydrochloric acid solutions at 10°, 20°, and 30° yield numbers agreeing to within 1 per cent. with those obtained by Kohlrausch and Déguisne, and the temperature-coefficient agrees even more closely. From previous determinations of the conductivity of potassium chloride, the mobility of the chlorine ion is calculated to be 54·5 at 10°, 68·5 at 20°, and 83·3 at 30°. Also, the following numbers have been arrived at :—

	10°	18°	20°	25°	30°
H′ + Cl′ ...	343·2	395·5	408·5	440·7	472·4
H′............	288·7	329·8	340·0	364·9	389·1

The error in these results cannot exceed 0·8 per cent., and the influence of the dilution, which has not yet been fully investigated, is probably not more than 1–2 per cent. The value at 25° is greater by 5·8 per cent. than that calculated by Ostwald and 3·8 per cent. greater than that given by Kohlrausch for 18°.

T. H. P

214. *Electrolytic Solution of Platinum by Alternating Currents.* **R. Ruer.** (Zeitschr. Elektrochem. 9. pp. 235–239, March 19, 1903. Communicated by the physikalisch-chemisches Institut der Universität Göttingen.)—The author describes experiments on the behaviour, in an electrolyte, of a platinum plate serving, at one and the same time, as electrode for an alternating current and as anode for a direct current, the densities of the two currents being varied independently of one another. Using 66 per cent. sulphuric acid at 18°, it is found that the platinum dissolves. When the alternating current is kept constant and the direct current increased, the platinum dissolved increases to a maximum, then decreases, and finally ceases. The same behaviour is observed when the direct current is constant and the alternating one variable. The oxidation potential of the anode of the direct current is lowered by the alternating current. The latter alone attacks the platinum if the acid contains an oxidising agent, such as chromic acid, a ferric salt, permanganic or persulphuric acid, or even free oxygen. The alternating current increases the oxidation potential of an oxidiser at high concentrations, but diminishes it at low concentrations. In solutions of ammonia, hydrochloric acid, sodium chloride, or potassium cyanide, which readily form complex ions with platinum, the latter is dissolved by the alternating current, without the direct current and without oxidising agents. In nitric acid solutions with an unvarying alternating current, the dissolution of the platinum has a maximum value for a medium strength of acid. Passive iron exhibits a behaviour similar to that described above for platinum. The results obtained indicate that the explanation of the passivity of iron as due to the formation of a layer of oxide is probably a true one.

T. H. P.

215. *Bipolar Electrodes and Metal Diaphragms.* **H. Danneel.** (Zeitschr. Elektrochem. 9. pp. 256–260, March 26, 1903.)—When a platinum wire is laid in an electrolyte along lines of current-flow, at a certain minimum value of the potential-difference, the wire takes up lines of flow, the more the stronger the current, until polarisation is overcome and bubbles are found at the ends of the wires. The longer the piece of wire or the smaller the e.m.f. necessary to break up the electrolyte, the more readily this result is reached: and the mid-point of the wire need not be within the liquid. Lead wire produces this result less readily than platinum; and carbon needs very high e.m.f.'s before copper will deposit upon it from a $CuSO_4$ solution. Carbon can be used as a porous diaphragm in sheets 7 cm. thick, and perforated lead can be used for diaphragms in a lead trough, say for zinc-refining at 2 volts. The metal of a diaphragm must always be negative to all metallic ions in the solution: the potential fall in the metal of the diaphragm must never be greater than what corresponds to the free energy under any possible reaction in the liquid; and the products of electrolysis must not be allowed to linger about the diaphragm. Observations made by Brochet and Barillet as to the deposition of copper upon unperforated diaphragms are explained, these depositions being limited within equipotential lines corresponding to potential differences within the metal exceeding the limits above referred to. [See Abstract following.]

A. D.

216. *Metallic Diaphragms in Electrolysis.* **A. Brochet.** (Écl. Électr. 35. pp. 139–144, April 25, 1903.)—When a perforated metallic diaphragm is used in an electrolytic cell, it will remain electrochemically inactive if the conditions are such that the difference of potential in the liquid between any pair of points similarly situated on the two sides of the partition does not exceed the electro-motive force of dissociation of the electrolyte, this difference of potential being the "drop" in the direction of the lines of flow of current down from one point on the kathodic face of the diaphragm, through the nearest perforation and up to the corresponding point on the anodic face. The greater the distance of such a pair of points from the edge of a hole the greater is this drop of pressure; and at a certain distance the drop will be equal to the e.m.f. of dissociation. Beyond this distance dissociation will go on, but within it the surface of the partition is electrochemically inactive. The author experimented with holes of various sizes, round and square, in a platinum diaphragm placed inside a copper voltameter consisting of a rectangular trough two opposite sides of which formed the electrodes of the cell. With relatively large current densities in the electrolyte, he obtained a sharp equipotential line around each perforation, outside which copper was deposited and within which the surface of the platinum remained clean. The smaller the current-density, or the lower the resistance of the electrolyte, the further was this line from the edge of each hole, and the more indistinct. The thickness of deposit was proportional to the distance from the line of separation. If the electrolyte has two or more dissociation-pressures corresponding to more than one reaction, an equipotential line should be formed corresponding to each. This the author intends to investigate. By using diaphragms having a large number of small perforations the whole of the metal may be kept electrochemically inactive, whilst it performs all the functions of a porous earthenware diaphragm. With thick diaphragms this is not possible because of the resistance of the electrolyte inside the perforations. The following conditions are cited as being favourable to the construction of a metal diaphragm which shall act only as a diaphragm and not at all as a bipolar electrode. (1) The perforations should be small. (2) The ratio of the surface of the perforations to that of the metal should be large, *i.e.*, perforations should be as numerous as possible. (3) The diaphragm should be thin. (4) The electrolyte should have good conductivity. (5) When

the diaphragm is thick its specific resistance should be taken into account; but this is generally prevented because economy decides the metal to be used. [See also Abstract No. 756 (1903).] J. D. C.

217. *Abnormal Electrolytes.* **P. Walden.** (Zeitschr. Phys. Chem. 43. pp. 385–464, April 21, 1903.)—After an extended review of previous work the author points out that hitherto too much attention has been given to the behaviour of electrolytes in aqueous solutions. The author shows that many substances generally regarded as non-electrolytes possess a measurable conductivity and can be decomposed into ions. The experiments given in this paper form the first portion of a series of researches on these questions. By measuring the conductivity, he finds that in such solvents as sulphur di-oxide, sulphuryl chloride, and arsenic trichloride, a large number of chemical substances which are neither acids, bases, nor salts are good conductors of the current. He calls these substances "abnormal electrolytes," and shows the nature of the ions to be as follows: (1) The halogens, bromine and iodine yield the ions $Br^{\cdot}$, $Br^{\cdot\cdot\cdot}$, and $I^{\cdot}$, $I^{\cdot\cdot\cdot}$. (2) The metalloids, phosphorus, arsenic, antimony, tin, and sulphur can form kations as $P^{\cdot\cdot\cdot}$ and $P^{\cdot\cdot\cdot\cdot\cdot}$, $As^{\cdot\cdot\cdot}$, $Sb^{\cdot\cdot\cdot}$, $Sb^{\cdot\cdot\cdot\cdot\cdot}$, $Sn^{\cdot\cdot\cdot\cdot}$, $S_2^{\cdot\cdot}$. (3) Tertiary nitrogen bases (quinoline, pyridine, picoline) form the divalent kations $(RN)^{\cdot\cdot}$. (4) Dimethylpyrone yields the divalent kation $[C_7H_8O_2]^{\cdot\cdot}$. (5) Alkyl radicles can exist as kations, *e.g.*, $(C_6H_5)_3C^{\cdot}$, $(CH_3)_3C^{\cdot}$, and others. (6) The existence of acid kations $(R.CO)^{\cdot}$ where R stands for an organic radicle, and of the kation $PO^{\cdot\cdot\cdot}$ appears probable. For the data upon which these conclusions are based, reference must be made to the original paper. F. S.

218. *Electrolytic Reduction of Potassium Chlorate.* **D. Tommasi.** (Comptes Rendus, 136. pp. 1005–1006, April 27, 1903.)—With reference to the results recently published by Bancroft, Burrows and Brochet on this subject [see Abstracts Nos. 173 and 1126 (1903)], the author of this note recalls the fact that he obtained almost identical results in the year 1877. J. J. S.

219. *Electrolytic Synthesis of Sugars.* (Engineering, 75. pp. 591–592, May 1, 1903.)—A briefly historical article dealing with the synthesis of organic compounds, and in particular with the experiments of J. Walther (Chemiker Zeitung, August 16 and October 18, 1902), upon the electrolytic synthesis of carbohydrates from a saturated aqueous solution of carbon dioxide, with or without the addition of certain salts or albuminoids. Compounds are produced at the kathode which are richer in carbon the greater the current density in and the p.d. applied to the electrolytic cell. Oxalic acid ($C_2H_2O_4$) is first produced at low current densities, and the carbohydrates ($C_6H_{12}O_6$) at higher densities. Sugars produced by this method exhibit rotary power and other properties characteristic of the natural products. [For further details the papers above referred to should be consulted.] The present article ends with a short comparison between syntheses produced by bacteriological and chemical means, and the behaviour of living and inanimate matter under stimuli. J. D. C.

220. *Melting Curves of Alloys.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 25–34, May 30, 1903.)—In former articles the author gave an expression for the solidification temperature of tin amalgams, derived from the general expression of the molecular thermodynamic potentials of either of the two components in the solid state and in the liquid alloy respectively [see Abstract No. 557 (1903)]. As many melting lines of the type of those of tin amalgam have since been found, it was proposed to investigate whether the latter are represented by the same formula. In the case of silver-lead and silver-tin alloys, great departures were found. It is shown that in both kinds of alloys, silver, at least for low concentrations, is present in the *atomic* form. After drawing attention to the fact that mercury dissolved in tin is likely to have undergone an association to within about 1, 5, the author proceeds to investigate the question as to the existence of an inflection point in the melting curve. A similar point is actually shown to exist in the case of $q_0. < 4T_0/1 - \frac{a_1}{T\sigma}$, where q_0 is the melting heat (in gram calories) of the metal separated in the solid state, T_0 the absolute melting temperature and $a_1 = aq_0 = (a_1 b_2^2 - 2a_{12} b_1 b_2 + a_2 b_1^2) b^3$. In the case of a_1, as ordinarily, being positive, the simple condition $q_0 < 4T_0$ will include the above condition and in most cases afford an excellent criterion as to the existence of an inflection point. A. G.

221. *Electrolytic Production of Hydrogen Peroxide.* **F. Richarz.** (Zeitschr. Anorg. Chem. 37. 1. pp. 75–80, Oct. 27, 1903.)—The author has been induced, by a statement of K. Bornemann [see Abstract No. 761 (1903)], to point out some facts relative to the electrolytic production of hydrogen peroxide as elucidated by himself. The author's experiments have shown, as opposed to Traube's researches, that the H_2O_2 is actually due to the anode, and that in highly concentrated sulphuric acid, no persulphuric acid can exist without the formation of large amounts of hydrogen peroxide in a short time. Previous experiments by the author have confirmed the hypothesis of the two atoms of oxygen molecules being separated in the formation of H_2O, whereas this separation does not occur in the formation of H_2O_2. The proof of the existence of a product of convection currents (or residual currents) for e.m.f.'s lower than 1½ volts, incapable of producing any visible electrolysis of water, was the main point in the author's earlier experiments. A. G.

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222. *Molecular Weight Estimation at very High Temperatures.* **W. Nernst.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 75–82, 1903.)—An apparatus for this purpose is described and illustrated, and data are given for the molecular weights of CO_2, Hg, H_2O, NaCl and KCl up to about 2,000° C. The two chlorides undergo dissociation up to 10 per cent. at the higher temperatures. S. R.

223. *Report of the International Committee on Atomic Weights, with Remarks.* **W. Ostwald.** (Zeitschr. Phys. Chem. 42. pp. 634–639, Feb., 1903.)—Ostwald objects to oxygen being taken as the reference element at 16, and protests against its adoption without any comparison with hydrogen as unit. S. R.

224. *Meteoric Iron from N'Goureyma, Soudan.* **E. Cohen.** (Amer. Journ. Sci. 15. pp. 254–258, April, 1903.)—The meteorite which fell on June 15, 1900, in the province of Macina forms a very irregular wedge-shaped mass of 37·5 kg. The peculiarly regular arrangement of the very large number of small troilites suggests that the originally granular mass softened throughout as it passed through the atmosphere, and cooled very rapidly. The chief constituents are: Fe 89·3, Ni 9·3, Co 0·6, S 0·8 per cent. H. B.